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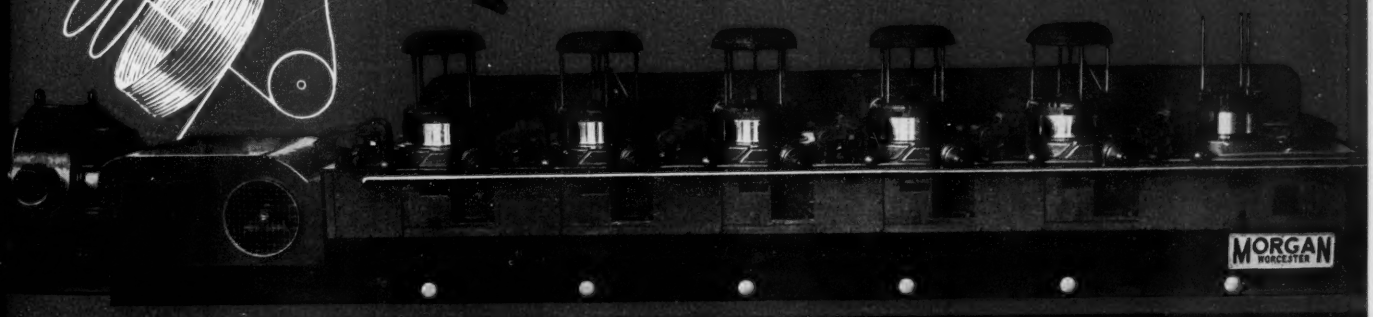

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PATENT NOS.
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396144 — 401589
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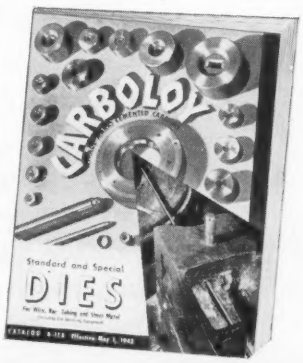

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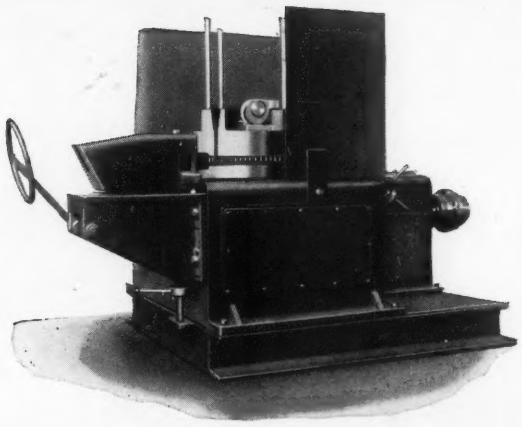

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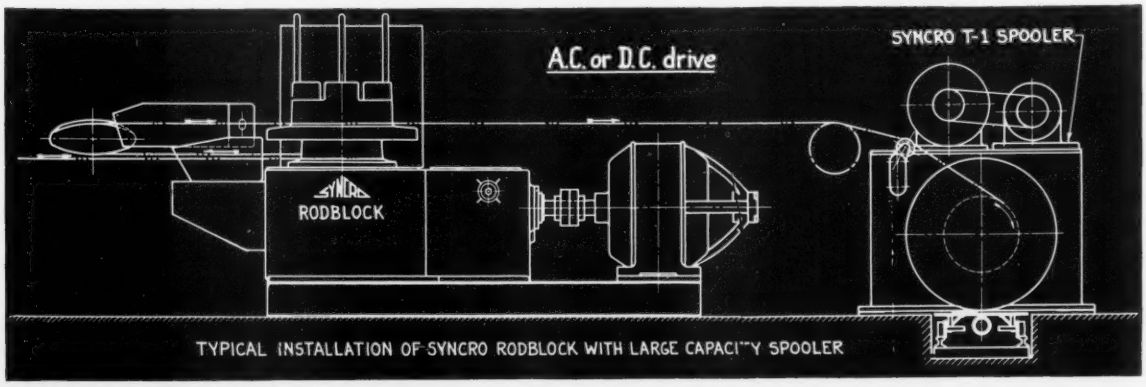

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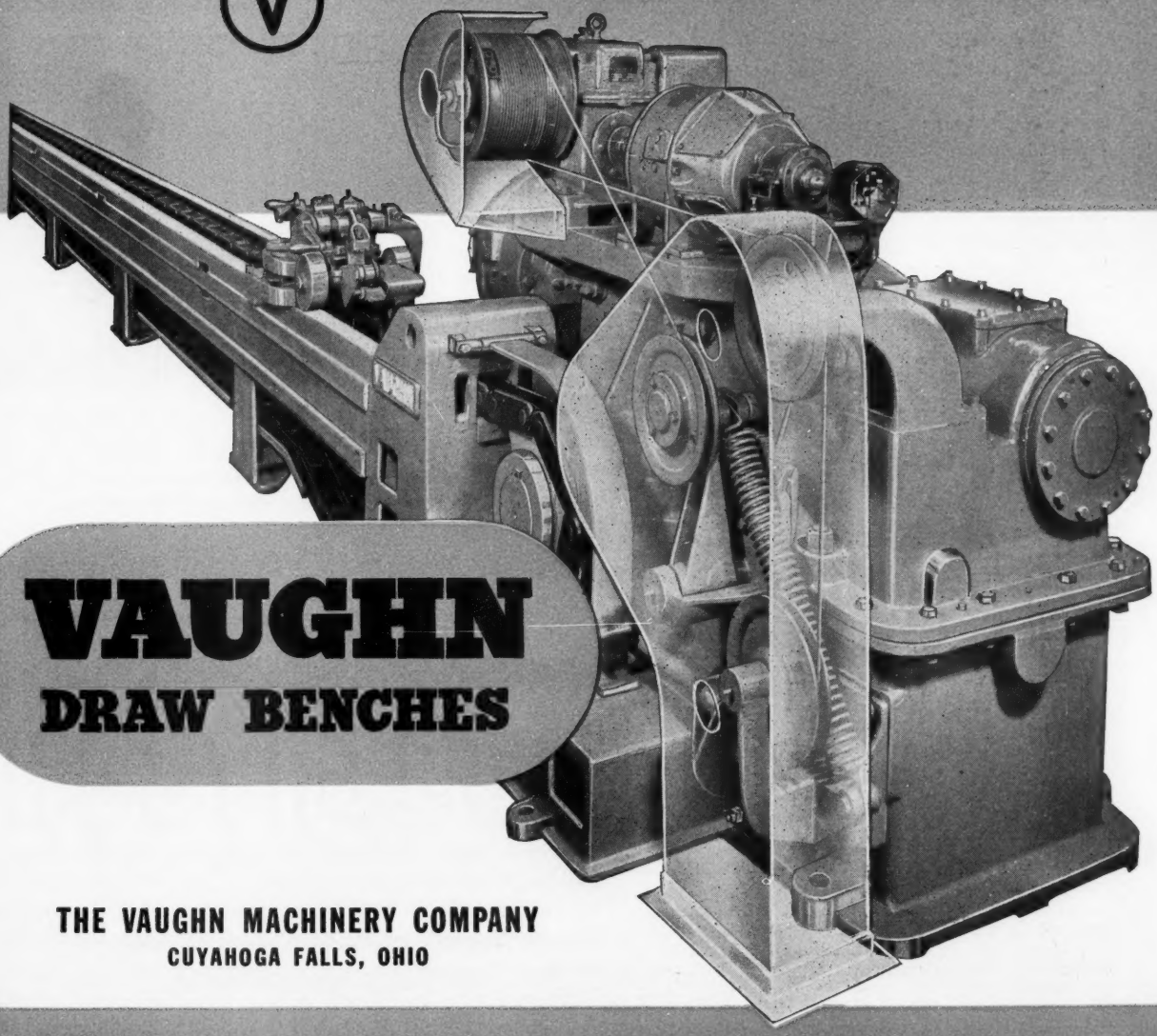

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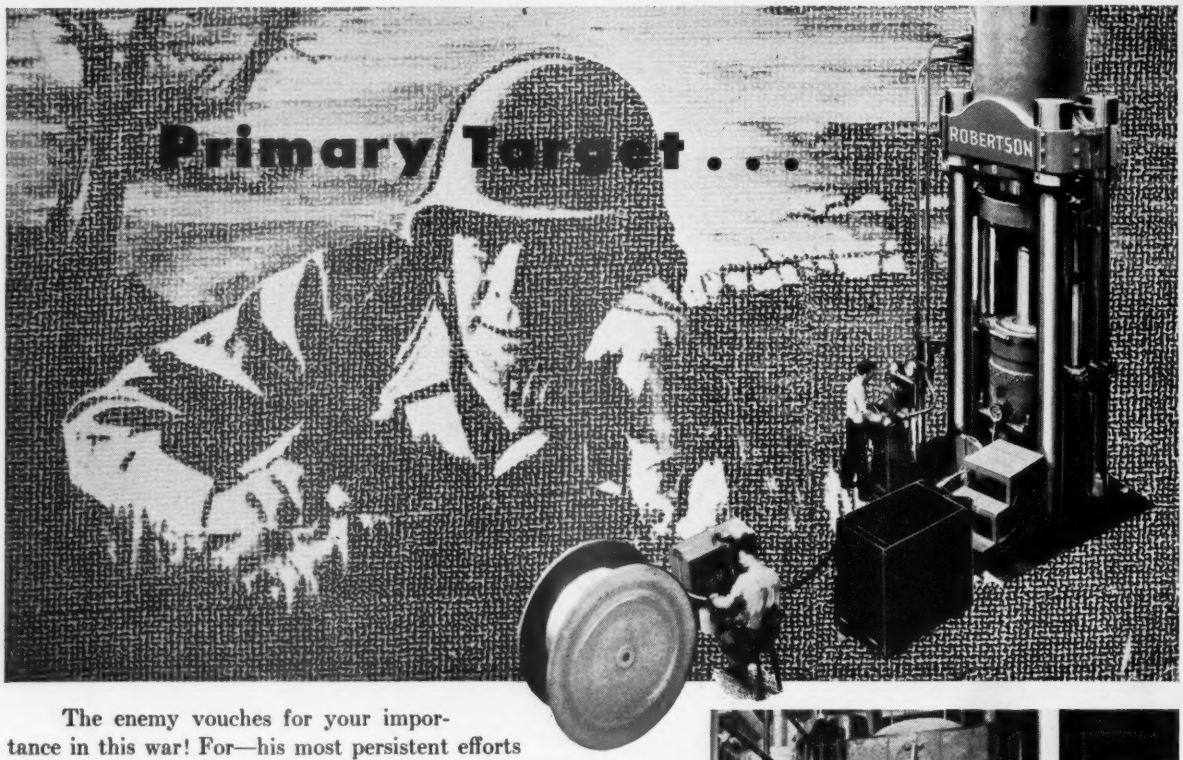

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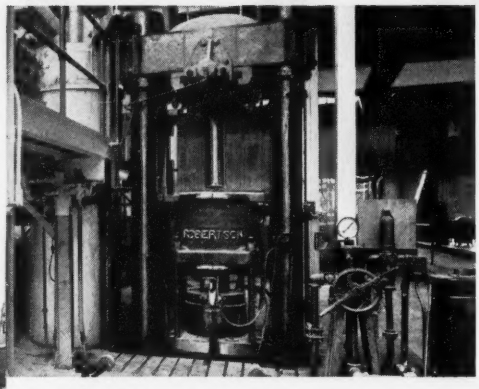

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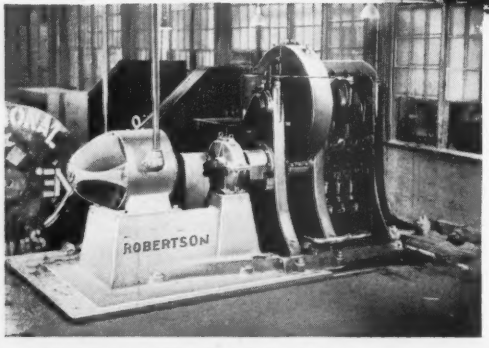

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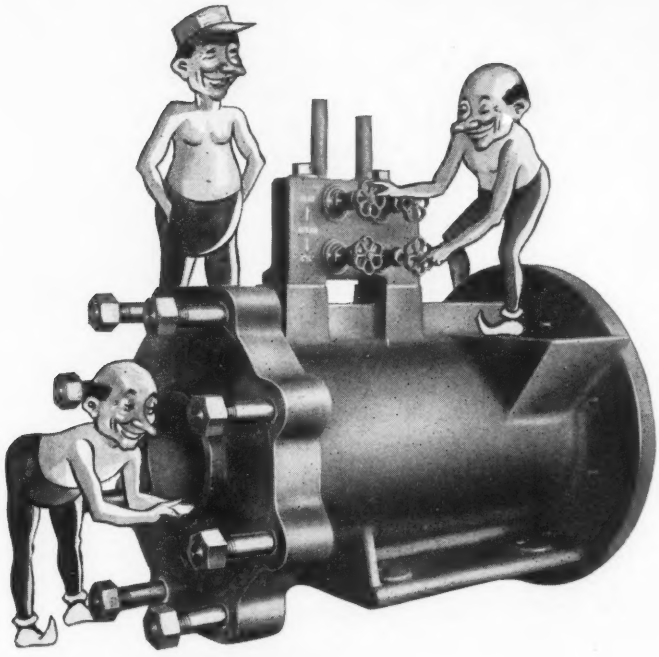

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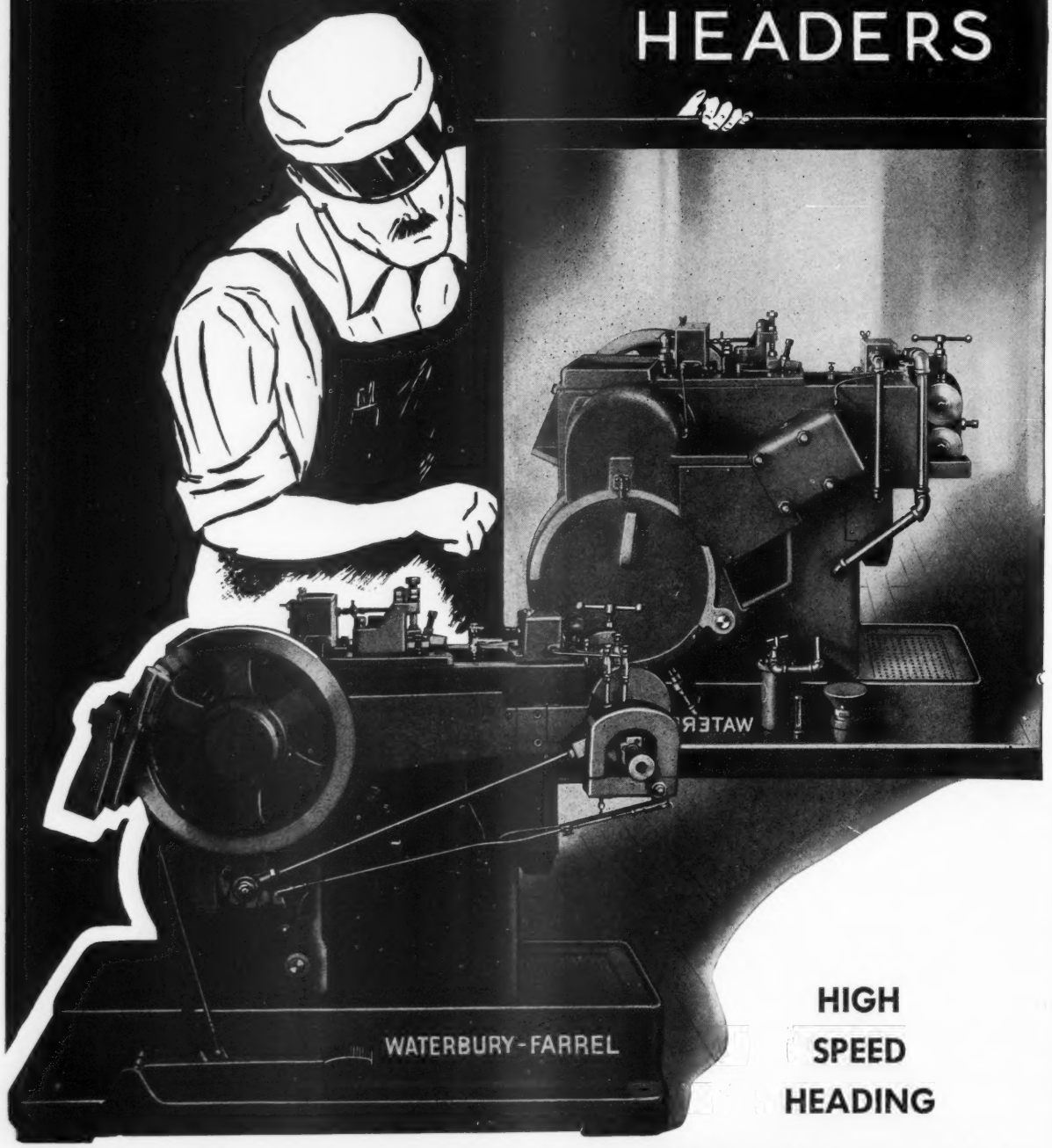

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A monthly publication devoted to the production of Wire, Rod and Strip, Wire and Rod Products and Insulated Wire and Cable

DRAWING — ROLLING — EXTRUDING — FORMING — FABRICATING

Vol. 18 JUNE, 1943 No. 6

Designated as

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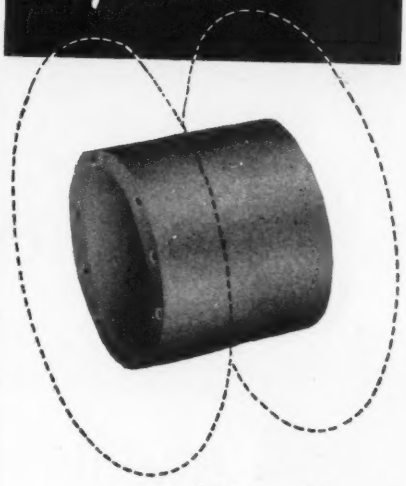

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A monthly publication devoted to the production of Wire, Rod and Strip.
Wire Products and Insulated Wire and Cable.
DRAWING --- ROLLING --- EXTRUDING --- FORMING --- FABRICATING

Vol. 18 JUNE, 1943 No. 6

Metal Working In Powder Metallurgy

By Claus G. Goetzel,
Works Manager, American Electro Metal Corporation,
Yonkers, New York.

Published in Three Parts:

Part I—June, 1943, Plastic Deformation and Powder Metals.

Part II—July, 1943, Industrial Practices in The Sintered Refractory Metal Field.

Part III—August, 1943, Cold and Hot Working Experiments With Sintered Iron and Copper.

PART I

Plastic Deformation and Powder Metals

THE techniques of powder metallurgy are especially adaptable to the fabrication of small parts complicated in design, with special structural properties and high quality finish; these may be manufactured more quickly and economically than by orthodox metallurgical methods. An organization, representing the powder metallurgy industry will soon select for manufacture ordnance parts which can be advantageously produced with available equipment.

✦ ✦ ✦

SUCH parts have physical characteristics differing from articles made from bulk material. Porosity, although lowering the strength, is beneficial in moving parts that require constant lubrication. However the industry has developed methods and means for adequately increasing the density (and strength) and is prepared to apply its practices to the manufacture of solid machine parts, especially of iron and steel.

As the apparent density of pressed and sintered bodies nears the density of solid metal, there is an improvement in physical properties, such as tensile, compressive and fatigue strength, hardness and electric conductivity; for they are dependent on the number and size of pores left in the finished product. Conditions at the grain boundaries and the final structure influence bending, torsion, and impact resistance, tensile elongation and reduction in area—which are usually low. The last two properties can be improved through the use of ordinary metal working practices. The application of these practices and the practical employment of the results will be discussed.

ROLLING, forging, swaging, drawing, and other forming operations change considerably the properties of metals, mechanical properties being the most affected. Plastic deformation, according to accepted theory, occurs by crystal fragments slipping along planes in directions which follow definite laws. Frictional resistance limits the extent of slip; increase in stress causes a repetition of the slip phenomenon. The grains are gradually elongated and, from an original haphazard arrangement, are oriented in the direction of flow. The resultant structure, regarded as cold-worked, is fibrous and increases the hardness, tensile strength and other mechanical properties and decreases the ductility. The effects are permanent at normal temperatures but an increase in temperature, as at annealing stage, restores the original structure.

✦ ✦ ✦

RECRYSTALLIZATION, the formation of new, small crystals, is the first phenomenon at elevated temperatures. Time and temperature allow the growth of larger crystals,

and this grain growth occurs even if only slight deformation is present. When recrystallization has just been completed and a fine polygonal grain structure produced, the metal is at its best condition, plastic, tough, strong and hard. This homogeneous condition, which explains the superiority of wrought material against castings, has replaced the cold-worked structure characterized by coarse grain size, envelopes of impurities surrounding the grains, some porosity and brittleness.

✦ ✦ ✦

IF, as in hot rolling or forging, the plastic deformation is performed at temperatures above the recrystallization range, the rate of hardening by working is slower than the rate of softening by annealing and the metal will not harden.

✦ ✦ ✦

IN applying the principles of powder metallurgy, the origination and nature of the powder material must be understood. The particle size of powder varies from fractions of a micron to several hundred microns. In bringing them into close contact, by applying great pressure to the powder in a mold, a compact is formed which has a degree of stability because of surface adhesion forces. Subsequent heat treatment, sintering, changes the structure; the atomic forces increase with rising temperature and, at the recrystallization temperature range, new crystallites are generated firstly at the highest energy concentration area, the borders and then inside the powder particles. The atomic mobility, as the temperature increases, is pronounced and the newly formed crystals tend to grow both inward to the particle and outward to neighboring particles, an "artificial" bond between constituents is newly created. Still further heating promotes the growth of grain boundaries as the old particle interstices give way.

CLAUS GUENTER GOETZEL

Studied mechanical engineering from 1931 to 1935 at Technische Hochschule, Berlin-Charlottenburg, Germany. Engaged in research and special training in metallurgy and testing of materials at Technische Hochschule and Staatliche Materialpruefungsamt. Graduated December 1935 with German engineering degree, Diplom-Ingenieur. Completed metallurgical and plant research experience in the United States and became connected with the Hardy Metallurgical Company in 1936 as metallurgist in charge of research laboratory. Entered School of Mines, Columbia University, 1937 and received Ph.D. Entered laboratory staff of American Electro Metal Corporation as assistant director of research and is now works manager of that company.

THE formation of grains in the solid state is in marked contrast to traditional methods where crystallization occurs during freezing of the liquid state. However, microscopic cavities are present in solid-formed grain boundaries, and only a "high sintering" operation, at a temperature near the melting point of the metal for a prolonged time interval, produces sufficient consolidation by grain growth. Then the total grain boundary area is diminished and the boundaries reinforced, the cavities being enclosed by the expanding grains or being completely closed up; figures 1 to 3 exemplify this structural change occurring during sintering.

✦ ✦ ✦

POWDER metals have some characteristics similar to massive metals, but generally the materials are inhomogeneous and structurally weak because of cavities or impurities. Therefore the behavior and qualities of powder metals must be considered similar to that of raw castings which are subjected to a limited degree of homogenization treatment; thus, specific properties, such as lack of ductility and shock resistance, are understandable.

✦ ✦ ✦

SINCE this fact was recognized early in the history of powder metallurgy, attempts to refine the structure were in line with established metal-working methods. The classic example of such applica-

(Please turn to Page 355)

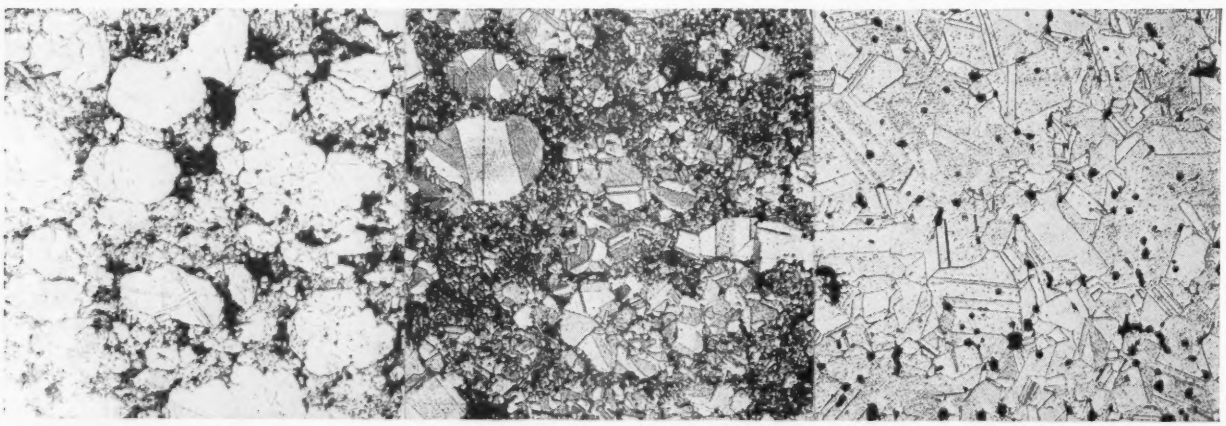

Fig. 1. Microstructure of Compact made from Electrolytic Copper Powder. Compressed at 45 tons per square inch. X 200. ✦ ✦

Fig. 2. Microstructure of Same Compact after Sintering at 600 Deg. Cent. for 16 Hours in Hydrogen Atmosphere. X 200. ✦ ✦

Fig. 3. Microstructure of Same Compact after Sintering at 900 Deg. Cent. for 16 Hours in Hydrogen Atmosphere. X 200. ✦ ✦

Some Effects of the War on Mechanical Spring Design and Inspection

By Robert L. Adams, Ensign, U. S. N. R.,
Formerly of Barnes-Gibson-Raymond Div.,
Associated Spring Corporation

Part II
Finished Spring Inspection

INSPECTION of the finished parts has also involved many interesting problems. All phases of this type of inspection have become a production proposition because of the large number of parts which must be individually inspected. Dimensional inspection has become a series of large volume bench operations in many instances. Concern over this type of inspection, however, has been more or less confined to the ability to hold exacting and sometimes incongruous tolerances, rather than difficulties with the inspection methods.

✦ ✦ ✦

THE majority of dimensional troubles with coil springs have been as much a matter of poor design as of manufacturing difficulty. This often resolves into an inspection problem to get the parts approved for use. Since these errors in design also effect the required loads, it may be appropriate to consider the matter as a single related problem of coil spring design as it affects dimensional inspection and load testing.

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THIS design deficiency problem has been a chronic one on government blueprints. It usually shows up as a discrepancy between the number of required coils and the spring rate or solid height. These prints have consistently failed to recognize the importance of the type of ends used in calculating the solid height of a given design. The solid height of open and closed end springs alike are often figured on the basis of the wire size multiplied by the total number of coils. This is correct only for a fully ground spring with closed ends, and then represents the theoretical minimum. An open end spring with the same number of total coils as a similar closed end spring will have a solid height about one half the wire size greater than that of the closed end type after both springs are ground. This is because it is possible to grind about one half a wire thickness from each end of a closed end spring, while only about one quarter of a wire thickness may be ground from each end of the open end type. Further grinding of the latter type will only reduce the number of coils, thus removing active wire from the spring. The figure of one quarter wire thickness for an open end type is subject to slight variation, but represents average conditions. The exact amount which can be removed without grinding the ends to a feather edge depends somewhat on the pitch of the spring. It should be apparent that, for the same number of coils of the same wire size, both types of ends will give the same solid height before grinding. That this solid height is $(N + 1) \times d$ where N is the total number of coils and d the wire diameter is not fully appreciated by many designers. However it is simple geometry to show that for an unground spring the number of wire thicknesses is always one greater than the number of total coils.

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A SPRING simply cannot be made to meet load requirements unless the dimensions are reasonably consistent with the mathematics of the design. If the inconsistency is too great, some of the dimensions of the spring must be changed in order to correct the design. The requirements regarded by the spring-makers as most critical are the solid height, diameter, and loads. These three factors are determined by the allowable space and the work the spring is to perform. The wire size, free length, and number of active coils are merely a means of attaining a proper balance of the first three named. If the calculations on a blueprint are incorrect, the latter three requirements must be varied to suit the first three. If the solid height called for is less than can actually be obtained, either or both the number of coils and wire size must be reduced. This leads to the effect of these dimensions on the required loads.

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IF the number of coils are reduced, the rate of the spring is naturally increased. Rate, as mentioned here, means the load in pounds which the spring will develop per inch of deflection. It is inversely proportional to the number of active coils. Since the rate of the spring is very important if more than one loaded height is specified, decreasing the number

Any opinions expressed in this article represent those of the author and are not to be construed as being the views of the United States Navy.

Part II
Finished Spring Inspection

Material Inspection
Part I
Was published in the May Issue

of coils often leads to trouble in holding the load limits. Sometimes this can be done successfully by building the spring to be on the low limit of the first load and high limit of the second load.

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IN these cases it is usually necessary to make the free length less than the required limits due to the increased rate. Occasionally the rate of the spring, as originally drawn, is higher than the rate necessary to give the specified load characteristics. If in addition to this, the number of coils must be reduced in order to meet the solid height, the problem becomes still more difficult. If the job can be done at all, the free length, number of coils, and possibly the wire size may not be strictly within the blueprint specifications. Yet the spring will perform the task for which it was designed. In connection with the above, it should be remembered that when more than two loads with limits are required, the load-deflection or rate curve of the spring should pass through both mean loads. This is an axiom of spring design and holds for both constant and variable rate springs. Because a spring is used in ordnance equipment makes it no exception to this general rule.

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IT is believed that if these prints were set up with the solid height, diameter, and loads as mandatory requirements; and the free length, wire size, and number of coils as advisory data much time and expense would be saved. This has been done recently with some government prints. In spite of this fact the advisory data is still regarded as mandatory by most government inspectors. Considerable difficulty is experienced in obtaining even the slightest variations from it. This attitude defeats the purpose of the system. The advisory data should be regarded as such; put there to allow necessary deviations for inaccuracy of design and manufacturing variations. It should not be strictly interpreted in the same manner as the mandatory requirements. The advantages of this system, without in any way jeopardizing the quality of the product, should be apparent to inspectors having an understanding of the few simple principles mentioned above.

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THE proper load testing of springs is in itself quite an art. The fundamental consideration of any method of load testing is to make certain that the accuracy of the test method is sufficient for the load limits being checked. The enthusiasm of an inspector for a machine with a dial giving a direct answer to his problem often overshadows his appreciation of the limitations of the accuracy of the machine. In using a scale of any type the range should be carefully considered to make sure that the dial may be read to within the load limits required.

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WHEN testing springs requiring a long scale travel in order to check loads the effect of the length of travel on the load reading should also be taken into account. If the loading arm or plunger is not sufficiently stiff, errors may creep into the reading due to eccentricity of loading. The size of the arbor over which the spring is tested also has quite an effect on the load reading. This is due to the tendency of such springs to buckle as they are loaded in compression. In general the arbor used in this work is the same size as the part over which the spring is intended to operate. If the spring operates in a hole a likewise procedure is followed in determining the hole size to be used in testing.

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IT will also be found that the method of taking the load will affect the scale reading on springs of this type. By this is meant whether the reading is taken by bringing the spring down to the loaded height and reading the scale, or whether it is done by going below the loaded height and bringing the spring back up to the loaded position. In the first case the friction forces of the spring buckling against the arbor are acting to increase the scale reading. In the latter case they are working against the load developed by the spring, thus decreasing the scale reading. For both methods the spring should be tapped lightly and the arbor rotated if possible to keep the friction effect to a minimum.

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WHICHEVER of the above methods is used is not as important as an agreement by all parties concerned as to which course will be followed. This is essential if consistent results are expected by both the spring manufacturer and the user or government inspection agencies. It has been found in actual practice that the agreement of load checks of the same spring on several different scales will not be much closer than 1 to 3 per cent, even though all the scales are carefully calibrated and in good repair.

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THE accuracy with which the travel of the scale can be measured is an important factor of scale testing, and probably one of the causes of the expected error mentioned above. This accuracy is particularly important when testing high rate springs with a short travel between loads. In these cases an error of .001 to .002 inches in setting up the loaded height on the scale can often give a reading showing a perfectly good spring to be off on load. Another very important phase of this type of testing is to make certain that the face of the scale loading plunger is exactly parallel with the scale pan. In other words, the load must be applied perpendicular to the pan, and parallel to the axis of the spring. The importance of this when load testing stiff, short travel springs cannot be overemphasized.

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THESE two types of errors can occur on any type of spring or balance scales and are regularly encountered on scales using a power loading device. Many scales currently used by various industries for production load testing are equipped with an air cylinder

to provide the load on the spring. In many cases the use of an undamped air cylinder has caused such errors, due to the constant hammering on the scale frame as the piston reaches the limit of the stroke. The use of a cushioned air cylinder has alleviated the difficulty, but scales of this type should be frequently checked in order to maintain their accuracy.

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ANOTHER method of production load testing is the use of the so-called dead weight fixtures. This type of fixture is widely used for testing small springs developing light loads. It is also used for testing torsion springs. The same criterion of accuracy of the test fixture relative to the load limits to be measured applies to dead weight fixtures as well as scale testers. The idea that because the loading weight of such a fixture may be very accurately machined, thereby insuring correct results, is somewhat of a fallacy. It often obscures the fact that the design of the fixture proper must be very carefully undertaken to assure that the load is always applied under the same conditions. These fixtures must be made so that every spring tested is supported and acted upon by the weight in exactly the same manner. The friction forces of the weight sliding on its pin, or rotating on a supporting arm, must be kept at a minimum. It would appear unnecessary to emphasize these two points, but their neglect has caused more than one disagreement in load testing springs with fixtures of this type.

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THE final phase of load testing might be called dynamic load testing, or the testing of finished springs under fatigue loading conditions. The efforts of the spring and wire industries in this direction have been toward developing materials with known endurance properties. These known properties may be taken into account, so that for a given stress range, a maximum operating stress may be determined below which the material should operate indefinitely without breakage. As is well known, this type of work has met with considerable success. The values for various kinds of materials are common knowledge. This work is based upon the material being of representative quality. When determined, these characteristics are regarded as constants of the material. Percentage testing of finished springs in production has been found unnecessary, as the variation of these fatigue properties, other than those within the limits of experimental error, is due to the quality of the wire. This, as previously described, is under strict laboratory control.

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IT is generally accepted that ten million cycles is the minimum number that steel must run before assuming that it will not break if the run is continued for an infinite number of cycles. For this type of work it has been possible to build up sets of curves showing the limiting maximum stress range for any desired number of cycles. However, as mentioned before, these curves are inaccurate in the ranges for a small number of cycles. Some investigators have done research work on limiting stresses in the neighborhood of 0 to 50,000 cycles, but the results are closely linked with the laws of probabilities. They are inconclusive so far as practical use is concerned.

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FROM this it should be evident why the spring engineer looks with considerable skepticism on the value of percentage production fatigue testing of the gun springs discussed earlier in this article. Particularly when the means of the fatigue test is the reciprocating motion of a power press turning about 600 revolutions per minute. The similarity of the loading conditions on a spring in this test to those conditions as it is used in a gun might be roughly compared to pushing the spring with one's thumb as against hitting it with a sledge hammer.

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IT has been claimed that a relationship has been found to exist between the number of cycles a spring will last in the gun and the number of cycles it should negotiate on this fatigue tester. In the experience of the writer this claim was not borne out in one single instance. None of the springs so tested ever failed to meet the fatigue test requirements with a margin to spare. Neither did any of these same springs fail to lose considerable more load during 75 rounds in the gun than they did during 50,000 cycles on the fatigue tester.

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A PECULIAR phase of these tests as required on government drawings is the fact that the loads required after fatigue testing are often but forty to sixty per cent of the static load required of the spring before fatigue testing. These springs are usually so highly stressed that they lose this much load if merely pressed solid a few times. The writer has often wondered why it was necessary to fatigue test such springs in order to arrive at the conclusion that they would set when used. Another source of wonderment has been the requirement of loads which are known to be so high that they will decrease forty to fifty per cent during the first few rounds of firing. The springs could be built to the correct loads in the first place and would be much easier to make and easier to inspect properly. A final peculiarity is the appearance of this fatigue test requirement on drawings for springs which are not operated under fatigue loading conditions.

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ALL that is mentioned above is loss of load, and so far as can be seen, that is all this test shows; loss of load during the test. To show the uselessness of such a procedure for determining the life of a spring before breakage, **Mr. Elliot Stewart** of William D. Gibson Division of Associated Spring Corp. conducted an interesting experiment.

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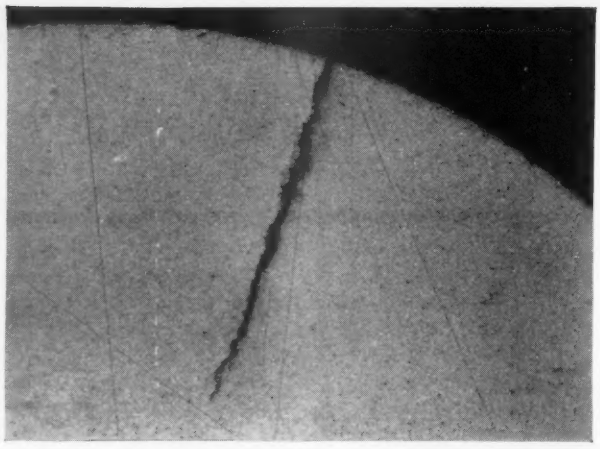
MR. STEWART examined his supply of premier wire, which is the cheapest type of hard drawn wire, and selected the sad-

dest specimen he could find. Springs made from this bundle of wire, full of scratches and seams, were then given a drastic quench. This treatment opened up radial hardening cracks some of which were fully twenty five per cent of the wire diameter in depth. The accompanying photograph shows a cross section of one of the springs after completion of the test. These springs were then run on a 10,000 cycle fatigue test at various stress ranges up to a maximum of 14,400 to 122,500 pounds per square inch corrected stress. The latter maximum is very close to the torsional yield point of this material as ordinarily used. Out of some two or three dozen springs so tested none broke during the 10,000 cycle run.



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IT would seem from the results of this experiment that very little is known about the factors affecting the life of highly stressed springs expected to operate for a relatively low number of cycles. It would also appear that more research work should be done in an attempt to develop a logical and reliable method for predicting the life of these springs before wasting further time and money on production testing of this type.

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THE final phase of inspection yet to be considered is that of surface and finish inspection of the completed spring. Surface inspection is taken to mean a visual examination for surface defects of a nature similar to those found on the raw wire. In this case the wire is also one hundred percent examined for these defects after fabrication into springs. Finish inspection is regarded as a visual examination for defective workmanship, often done in conjunction with surface inspection. It also includes the checking of protective coatings such as cadmium plating, for salt spray resistance and general appearance.

SURFACE inspection as well as finish inspection is a standard procedure on nearly all aircraft engine valve springs and accessory springs. Extended life is expected of these parts and the possibility of failure must be eliminated regardless of the cost. The backbone of surface inspection of this type is the use of magnafluxing to reveal any slight seams or other defects in the surface of the wire. Magnafluxing has been used for some time by the spring industry. But with few exceptions until recently, it has been used more as a laboratory check than as a method of production inspection. The developing of a department with a sufficient number of well trained operators to inspect the volume of such springs now being produced was quite a problem.

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IN the course of this development, and in the use of springs so inspected, some interesting aspects of magnafluxing were encountered. Not the least of these was some controversy over the proper method of magnafluxing springs. The average spring to be magnafluxed in large quantities is not a large spring, generally running less than one quarter inch in wire size with less than a dozen coils. Experience has shown that the dry residual method is satisfactory as well as convenient for this size of spring. A coil spring is a very difficult shape to magnaflux inspect properly. In order to obtain best results it is essential that the operator be able to handle the spring so that it may be viewed from any desired angle. The dry residual method has met this requirement. It has also proved to be sufficiently sensitive for this type of work. It has been successfully used for about fifteen years for the magnafluxing of high powered aircraft engine valve springs.

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CONSIDERABLE opposition to this method in favor of the wet continuous method has been recently voiced by one of the government agencies, and other quarters who would appear to be more familiar with the technique of magnafluxing crankshafts and connecting rods than with the magnafluxing of springs. Such parts are undoubtedly more effectively magnafluxed by the wet continuous method because of the heavy currents required for producing a satisfactory field strength. It is also difficult to maintain a satisfactory residual field in such parts. The greater ease of applying the ferromagnetic powder to large parts is another important advantage of the wet method. However springs of the sizes mentioned cannot be exposed to a heavy continuous current without running the risk of overheating the wire and lowering the physical properties of the spring. The overheating of heat treated spring wire with an electric current also causes a curious embrittlement effect. The same heavy current may be used instantaneously without danger of overheating and the residual field so produced is sufficiently permanent to remain during the inspection operation.

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THE writer has observed valve springs being magnafluxed with the wet continuous method by one of the large engine manufacturers, and would not care to be responsible for the results of such an inspection. Due to the spring being slightly compressed by the electrodes during the en-

(*Please turn to Page 350*)

Lacquering of Insulated Wire and Cable

Part II

By C. A. Litzler, Chief Engineer,
Industrial Oven Engineering Co., Cleveland, Ohio

Part I

A description of the operation and design of a wire and cable finishing system for lacquering insulated wire and cable as developed by the Industrial Oven Engineering Company of Cleveland, Ohio, was published in the May 1943 issue.

Part II

A description of the various means available for handling wire efficiently through lacquering processes.

IN Part No. I of this series of articles on the problems of lacquering of insulated wire and cable a general description of the drying tower itself and the lacquer pots was presented. The description covered modern high production tower design that is applicable to all classes of varnished and lacquered wire and cable from very fine gauges to heavy diameter cable. Considerable discussion was devoted to the effects of dryer air velocity upon the cable finishes, together with a detailed discussion of the drying process in the braid. The effects of preheating the wire before lacquering, and the possibility of hydroscopic moisture removal were presented. The design of lacquer pots, wipers, seals and sizing dies was briefly dwelt upon. In short, the application of lacquer to continuous cable and its subsequent drying was covered as thoroughly as conditions would permit.

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NOW, Part II of these articles covers various methods that can be used to handle wire and cable at continuous high speeds with positive control of wire tension at any speed of production and through any number of lacquer coats.

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IN the overall consideration of a complete lacquering system the method of handling the wire inside the drying tower is of the first importance. Long usage of the system shown in Figure No. 1 has determined its present acceptability.

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IN this system the wire or cable comes from the payoff stand; goes under an idler sheave; upward through the lacquer pot; thence, into the tower and over the top sheave of the tower. From the top sheave the wire travels downward and under the second lower idler sheave. Thence, again upward through the lacquer pot for the second coat, and then to the top sheave, angularly down and so continuing on depending upon the number of lacquer coats to be applied to the cable. On most classes of low tension wire and cable, communication and radio wire, six to twelve lacquer coats are applied; while in high altitude ignition wire sometimes more than twice as many coats are applied.

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AS points to consider, however, bear in mind that utmost efficiency can be obtained from a system of this type only if the vertical wire centerlines are suitable to the wire speeds, the tower height and the wire diameter. High towers, fine wire and high wire speeds may require much greater spacing than heavy cable running at lower speeds to prevent whipping of the strands and the possibility of wire entanglement and breakage. Wire and cable centers vary normally from 1-¼″ to 2″ with a normal condition of about 1-½″.

THE first sketch of wire handling has been shown to generally indicate what path the wire takes in process between the mechanical function of unwinding and windup. In Figures 2, 3, 4 and 5 are shown various process methods which are to be considered as being used in the system as shown schematically in Figure No. 1.

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BASICALLY, "any" wire handling system should be designed having as the main function driving of the wire at constant velocity through the lacquer pot; the wire to be held at a constant tension at the desired rate of production. This constant tension to be held at a desirable tension, and only enough tension to overcome frictional losses in the sheaves, the payoff reels and windup stand. The tension will not be very great, but it must be held constant. The driving of the wire through the pot must be done smoothly to prevent pulsation or jerkiness. Jerks, if encountered, would cause unequal impregnation, or would cause built-up sections in the lacquer coating and, of course, would change dielectric strength. Also, jerks would prevent smooth outside finishes. For the same reason, increases from starting wire speeds to full operating speeds must be uniform acceleration. Jerks in the wire drives, or pulsations if present tend to amplify themselves in the vertical travel in the towers and result in wire whip, which is not desirable.

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SMALL diameter wire to be processed through a large number of coats, thus brings an important and definite tension prob-

lem before the designer of modern high speed, highly efficient wire towers. He is then faced with a possibility of having to pull the wire through a multiple pass system where the total frictional drag may result in a greater tension on the wire than the cross sectional area of the wire can stand. The result is then, that stresses induced in the conductor cause it to stretch; thereby reducing the cross sectional area with resulting opening of voids in the insulation and the loss of dielectric strength.

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WIRE processors, after experimentation with wire handling systems, have determined the need for payoff and windup equipment of the wire tower to do the following:

A. Pull the wire through the lacquer or varnish pot smoothly.
B. Unwind the wire without excess tension.
C. Process at a definite proper tension.
D. Rewind the wire at the same proper tension.
E. Handle any number of separate passes with minimum stress to the conductor and stretch to the braid.

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BASICALLY, the problem in actually selecting equipment to accomplish this function centers around several distinct points. The first point is the actual wire sizes to be processed. Next, the operating speeds at which the wires are to be handled should be determined from production requirements. From these two facts the type of equipment then can be selected.

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UP to the present time practically each manufacturer has had his own idea as to how this should be done. Some systems are fair, some good, but very many of them are obsolete. Some have been in operation since the days when wire was processed at slow speed and when very little thought was given to high speeds and positive speed control. In considering the type of equipment that is available; four basic types of systems evolve. They are as follows:

1. Friction unwind of wire with controlled processing speed, and having tension controlled windup.
2. Driven unwind and windup of wire, both with controlled processing speed and having controlled tension on wire.
3. Friction unwind of wire, using capstan drive and having slip belt for windup.
4. Friction unwind and with friction windup having slip belt wire drive.

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THESE types of systems are diagrammatically shown on Figures 2, 3, 4 and 5.

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IT is the purpose of this article to explain the design features in all of them, and the relative merits of each, together with some idea of the classes of work that can be handled most efficiently by each one.

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Friction Unwind—Controlled Processing Speed and Controlled Tension Windup

FIGURE No. 2 shows diagrammatically the arrangement of functional equipment to handle reasonably small diameter wire to large diameter cable through a small or large number of passes. This equipment arrangement can be used on the more or less common types of insulated wire or cable, such as Army/Navy cable in gauges from 24 on down to 0000 or even greater. By reason of the basic adjustable speed range, the desired rate of production can be set and so it is ideally suited for very high wire speeds encountered in 24 gauge, and yet also to the lower cable speeds encountered in the heavy cable.

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ESSENTIALLY, it consists of an unwind stand arranged with a friction pulley on the reel shaft, which pulley is contacted by a friction material faced brake block mounted on a pivoted arm. This arm is equipped with adjustable counterweights so that braking pressures may be adjusted over a considerable range. From this reel the wire goes into the lacquering system for any number of coats. After the final pass the wire is carried around the capstan. From the capstan the wire passes around a float roll,

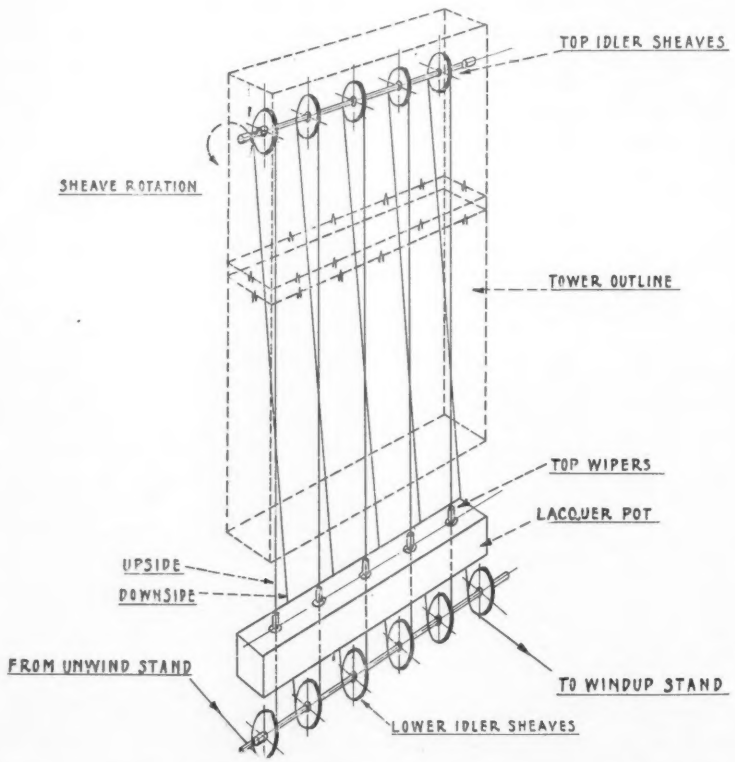

Fig. 1. Simple Method of Handling Continuous Wire Through Impregnation of Pots and Drying Tower.

and thence through a traverse mechanism (not shown) and then is wound on the windup reel.

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IN the proper design of the unwind stand the following facts must be considered:

1. **Change in reel velocity throughout maximum to minimum wire diameter changes as effected by constant maximum or minimum wire speed.**
2. **Momentum of combined wire and reel mass that must be counteracted by breaking pressure on brake pulley.**
3. **Original inertia of reel and wire mass at maximum condition plus brake drag.**

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IF the wire speed change range in the entire system is, for example, from 50 to 200 F.P.M. considerable reel velocity changes are encountered from slowest reel speed (at maximum diameter of reel at slowest speed) to the highest (at maximum diameter of reel at highest speed). With a standard 36″ diameter reel with 24″ diameter barrel this change in reel velocity is from 5.3 R.P.M. to 64 R.P.M. This change ratio is 12 to 1.

$$\text{or: CR} = \frac{\text{RD Max} = \dfrac{\text{WS Max}}{\text{RD Max} \times \Pi}}{\text{RD Min} = \dfrac{\text{WS Min}}{\text{RD Min} \times \Pi}}$$

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THIS change in reel speed is only part of maximum load that is to be considered in the design of the tension device. The other factor is momentum.

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EMPIRICALLY, the diameter of a full reel and its weight determine the momentum. Without going into the calculation here, the ratio of the momentum of a full reel (based on a 36″ diameter reel and 24″ barrel) to the momentum of an empty reel is roughly 9 to 1. This is a further and additional variable element of tension belt on slip clutch.

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ACCORDINGLY, in payoff stand design some fairly reliable method of varying the torque to the reel shaft must be used. Usually this is done by means of leather belting, canvas webbing or other flexible materials, whose coefficient of friction is great enough to put a drag on the pulley over the entire speed change range. These belts are usually equipped with springs or weights in an attempt to vary the tension. A more suitable means of accomplishing braking action economically is the adjustable counterweighted arm. At the outset of running a full reel the counterweights are moved to their minimum position until the reel comes to operating speed. This is done to reduce the original tension until the reel has overcome its original inertia. Thereupon, the counterweights are moved to the maximum position. As the reel is paying off, the operator occasionally moves the counterweights back to reduce the drag. Theoretically the counterweights should be moved back regularly as the reel diameter decreases. Some equipment is available to do this automatically, but it is not flexible enough for very high speed on certain classes of wire or cable. For the average classes of wire and cable this type of unwind stand is suitable, providing the friction device is of proper design.

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WINDING the wire at controlled set speed (but which would be variable or changeable in speed range) and at controlled tension is important to high speed and rigid specification wire and so requires equipment specifically designed for this purpose. Figure No. 2 shows a diagrammatic arrangement of such equipment.

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BASICALLY, it consists of a suitable two, three or four wrap driven capstan, a hydraulically operated variable speed transmission, a weighted float roll stand or accumulator and a main variable speed mechanical drive. This equipment, properly driven and synchronized, will rewind the wire or cable at controlled constant tension, controlled constant operating speed; yet with speed or tension each being adjustable independently within their own ranges of speed and tension.

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THE main drive for the wire is naturally the capstan. which in the case of wire or cable is two driven drums around which the wire passes. The capstan drives the wire due to the developed friction between the wire and the surfaces of the capstan sheaves or drums. To prevent creep of the wire, the capstan drums must be of the same large diameter and both driven in sychronization at the same peripheral speed. If unequal drum diameters are encountered, the drum with the

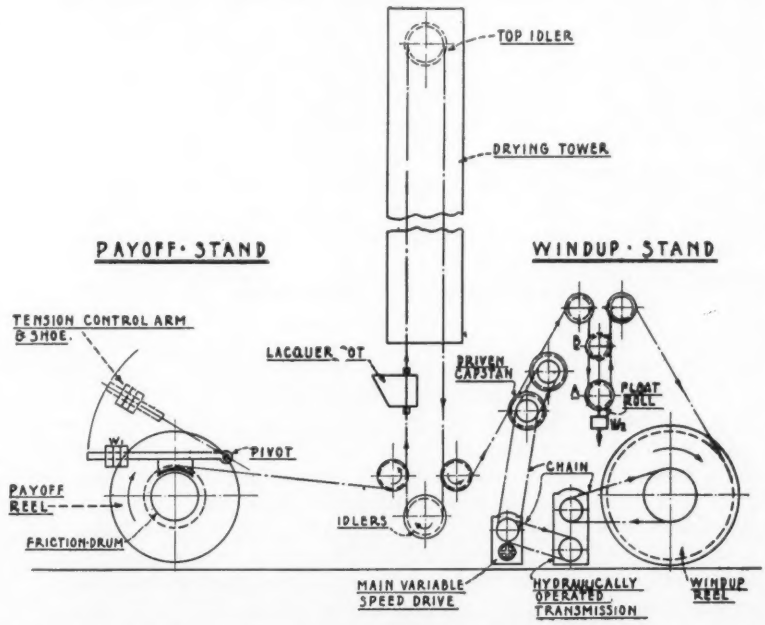

Fig. 2. Friction Unwind Constant Speed and Tension Wire Windup System.

higher peripheral speed throws unequal tension on the wire on one side of the capstan and slack on the other side. This slack and tension condition is apt to develop into pulsation and stretch in the wire. Sometimes, only one capstan drum is used instead of two, but with high speeds two or three spiral wraps on one drum may cause binding and rubbing of the outgoing wire on the wraps still on the drum.

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HOWEVER, despite whether one or two drums are used the primary function of the capstan is to **smoothly** draw the wire through the system, regardless of how it is to be wound up.

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THE capstan shown in Figure No. 2 is a double driven capstan with a main drive directly taken from the output shaft of the variable speed control. Shafting could be used to drive it and in certain layouts positive drive roller chain might be employed. Regardless what power transmission medium is used, the fact still remains that the capstan is driven in positive synchronized relation to the main variable speed motor drive.

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THE prime mover of the entire system is usually a mechanical variable speed motor drive unit. This unit has a speed variation range of three or four to one, so that the wire speeds can be controlled and set at any speed between say 50 up to 200 feet per minute. This allows most flexible operation of one standard design on classes of wire processed at high speed, or cable running at lower speeds.

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FROM the output of this main variable speed unit one power takeoff drives a capstan, while another takeoff drives the hydraulically compensating mechanical speed transmission unit that directly controls the windup speed of the reel in direct ratio to the wire diameter throughout its diameter change from an empty reel to a full one.

THE hydro-mechanical transmission system being described is the Reeves cone pulley type, employing a block type endless belt to transmit the power from the input to the output shaft. By varying the opening of both the driven and the driven discs, varying output speeds are obtained. Now in order to change the output speed of this transmission in definite ratio to wire speeds, and to do this continuously without jerks and over and under speeding of the windup reel, hydraulic cone shifters are used. This hydraulic shifter is self-contained and consists basically of a small constant pressure constant volume hydraulic pump operating a two-way hydraulic cylinder through a special four-way operating valve. This hydraulic valve is built directly into the transmission unit and is equipped with adjustable operating handle. Varying the position of this handle from a mean setting will increase or decrease the output speed in infinite increments and with hydraulic smoothness. By positive gearing and chain drive these speed decrease or increase tendencies are transmitted to the reel smoothly and with quick response.

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THE next prerequisite is a mechanism which contacts the wire itself and transmits increments of tension or slackness in the wire to the hydraulic operating valve handle so that the increments of speed change may be passed on to the reel itself. This can be accomplished in several ways. One way is the use of a gravity floating sheave or accumulator, or as it is sometimes called, a compensator or dancer roll.

✦ ✦ ✦

THIS compensator is an idler sheave, usually mounted in a fixture which is equipped with vertical slides or guides so that it is free to move up and down in response to wire tension, either slackness or tightness. Usually the wire is wrapped under the sheave in the accumulator and further supported on its incoming and outgoing sides by other idler sheaves. Directly from the housing of this floating sheave a cable or linkage is run to the operating handle of the transmission unit. Simply, we now have a mechanism which is connected to a speed change device and which in passing over the wire is able to transmit tension and speed change tendencies. Refer now again to Figure No. 2. The float roll is free to travel from position "A" to "B" and back to "A". The driven capstan, a positive drive mechanism, delivers the wire at constant speed to the float roll. If for the time being the reel is winding the wire at the same speed of the capstan delivering it, no change in the float roll condition is encountered. However, the diameter of the wire winding on the reel is not constant and as the diameter builds up the windup speed increases (with reel speed constant). Accordingly, the tension on the wire increases. However, the float roll being free begins to feel the increased wire pull immediately and it is raised. As it is raised, suitable reversed linkages depress the operating lever and slow the output speeds of the windup reel to a point where the reel speed, regardless of diameter change, is running at wire speed.

✦ ✦ ✦

LIKEWISE, as reel diameter gradually builds up, the float roll, by its definite tendency to move in direct response to tension change, immediately and stepless, reduces the reel speed. Also, if the reel velocity is a slower speed the tension in the wire decreases and the float roll drops. This tendency to drop actuates the control lever on the hydraulic equipment and speeds it up to the wire speed.

✦ ✦ ✦

THE letters "A" and "B" represent maximum and minimum travel of the compensator sheave. Position "A" diagrammatically represents the highest reel speed and Position "B" represents the lowest speed. However, it is important to remember that the float sheave usually centers somewhere near the midpoint of these two positions. The hydraulic control equipment is sensitive enough and the actual float sheave movements

are so amplified that it requires only the slightest tendency of the sheave to raise or lower from its given position. These tendencies are then translated automatically and continuously to the windup reel. In terms of speeds, the selective synchronization of **actual** wire speed is within ½ of 1 percent of the theoretical true wire windup speeds.

✦ ✦ ✦

WITH heavy cable windup each successive wrap may represent considerable speed decrease increment, while with finer wire each wrap represents very small decrease increments. Despite the size of the speed change increment variation it nevertheless reacts in definite relationship to wire tension which integrates itself into a definite float roll position. Actually, it is from the float roll position that the windup speeds of the reel are determined. The capstan delivers the wire to the float roll at a constant speed and the float roll alters its position in relation to the wire tension. The transmission through its hydraulic system reacts from the float roll.

✦ ✦ ✦

ANOTHER important function of the equipment is the ability of the system to be adapted to constant tension within a considerable range. Normally, the wire should be wrapped as tightly as possible in order to assure maximum capacity for the reel size. In order that this might be done positively, counterweights are added to the float roll. In the case of fine wire a relatively lighter counterweight of say five pounds is required, whereas, on heavy cable the counterweight itself may weight one hundred pounds. By the addition of counterweights, constant tension is imposed on the wire, and when set this wire tension does not vary, regardless of the operating speed of the system.

✦ ✦ ✦

BASICALLY, this describes what might be classed as the standard controlled constant tension controlled constant speed windup system, together with the adjustable tension windup, such as is adaptable for the more common classes of wire, such as Army/Navy cable, radio and communications wire.

✦ ✦ ✦

QUITE often in the production of some specialty wire or high altitude aircraft cable, equipment is required that will lacquer up to, and sometimes more than, 28 coats. This imposes considerably greater tension on the wire than a six coat system. In some cases the tension required to pull the wire through 20 coats is beyond the tensile strength of the conductor and elongation of the core and braid stretch are very distinct dangers. In the case of a wire windup system, as indicated here, it is possible to drive synchronized helper sheaves which can be so arranged that they tie directly into the main drive unit and operate within the speed change range of the entire system. With helper sheaves added to the roll idler sheave assemblies it is possible to run any number of coats with a tension buildup no greater than is encountered in a five or six coat system. In effect, the helper sheaves act as additional driving capstans in between the various lacquer coats. By careful design these helper sheaves can be designed to eliminate wire stretch due to synchronization that is not accurate enough.

✦ ✦ ✦

Constant Speed and Tension System with Driven Unwind and Driven Windup

IN some classes of braided metallic cable, woven shielded cable, spirally ranged push-pull cord casing, and in some fine wire processing, where many coats are to be applied, or where by the nature of the cable or wire itself it can not stand any amount of tension, a system as shown in Figure 3 is used. Basically, it consists of a constant tension constant speed wire windup system, as described in Figure 2. In addition to this the unwind stand is driven. In the arrangement of equipment the unwind stand is basically the same equipment as the windup, other than it works in opposite function. One of the more important points in the consideration of a system of this type is the absolute synchronization of the unwind stand drive and the windup drive. This can be done in several ways, including the use of differential transmission in conjunction with variable speed drive units. Perhaps the simplest one is the system indicated on the sketch. It is simple because it requires the use of only one main variable speed drive, operating through suitable reducers to identical hydraulic operated speed transmissions. The drive for the unwind and the windup capstans are identical as are the reel drives. Due to the fact that only one main variable speed transmission unit is used, it is easily possible to adjust the base operating speed of the wire by the operation of a handwheel. From this point on, all synchronization is taken care of by the inherent designs of the equipment. In the case of the unwind stand, counterweights are added to the float sheave merely to impose tension on the wire from the reel to the capstan. This counterweight does not need to be heavy except in the cases of very heavy cable, because of the relatively small amount of tension required in the wire itself.

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IN a system such as this the only tension required on the wire other than that imposed on the windup stand float roll is the tension incurred in overcoming frictional losses in the sheaves and the lacquer pot itself. By careful layout of all equipment including the tower it is possible to have an extremely low wire tension for a large number of coats. In the case of some push-pull cord casings the maximum pull allowable is six pounds and the number of coats to be processed is twenty. Although this is a theoretical case, it could very easily be handled on a system of this type through the use of helper sheaves running every fourth coat. In other words, the frictional drag on the wire would be only that which is equivalent to running the wire through three passes in the tower.

✦ ✦ ✦

IN the case of this push-pull cord, or wire of this type, again

considerable thought must be given to stress imposed by the height of the tower and the resulting tension of the wire itself.

✦ ✦ ✦

THE detailed function of the unwind stand need not be described here, but the relative operation of all of the equipment is identically opposite with the windup stand.

✦ ✦ ✦

Friction Unwind—Capstan Drive with Slip Belt Wire Windup

IN the past, on some of the simpler types of wire, when specifications on wire finishes and dielectric strength were not rigid, accurate equipment was not definitely required. Usually, in a case of this sort, equipment of the nature indicated in Figure No. 4 was used.

✦ ✦ ✦

BASICALLY, it consists of an unwind stand as described in Figure 2. The wire is driven by a capstan which delivers the wire directly to the windup reel, which is driven by means of a slip belt. In speaking, in this case, of a friction belt we mean any device for varying the tension by mechanical means. The belt may be considered as a slip type clutch. It is the function in which we are herein interested, and not the design.

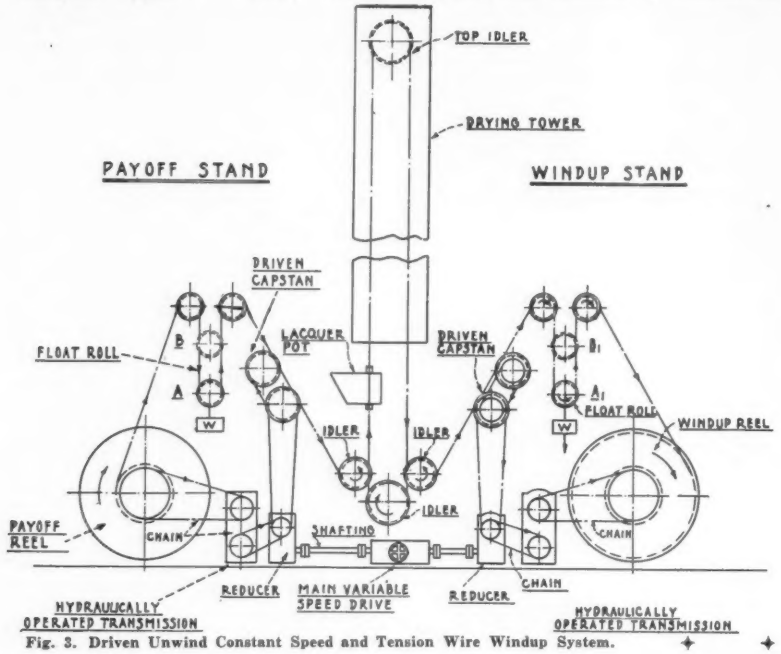

Fig. 3. Driven Unwind Constant Speed and Tension Wire Windup System. ✦ ✦

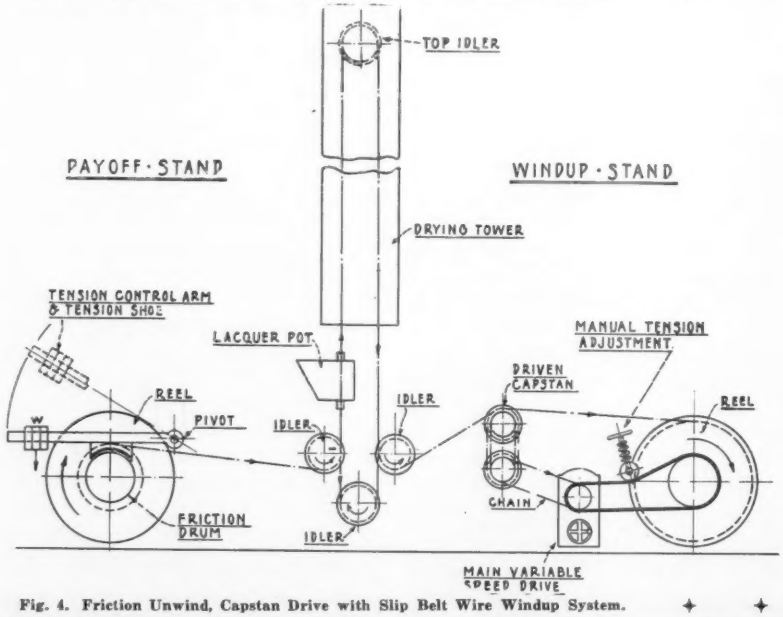

Fig. 4. Friction Unwind, Capstan Drive with Slip Belt Wire Windup System. ✦ ✦

✦ ✦ ✦

SYSTEMS of this type have been in use and have been somewhat satisfactory in handling the type of wire that was in use years ago. It was suitable for the operating speeds and the finish specifications that were in effect at that time.

✦ ✦ ✦

ITS use is definitely limited to a small number of coats on relatively heavy cable.

✦ ✦ ✦

ITS only advantage is in the fact that it is low in **initial** cost from an equipment point of view. From an operating point of view there is considerable loss of time in changing reels and there is considerable loss of effective length of wire on the reel due to lack of operator attention. The psychological effect on the operator of continuously changing belts every time he changes reels in addition to the change of tension adjustment, soon begin to show up in terms of wire output.

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IN addition to that, a system of this type does not lend itself to helper sheave drive as easily as any of the other systems previously mentioned.

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BASICALLY, in terms of equipment the windup mechanism consists of a driven capstan, which is driven positively from a main variable speed drive unit. This variable speed drive unit drives the reel shaft by means of a friction belt. The belt is provided with a spring mounted tension roller adjustable as to tension.

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ONE of the main limitations of a system of this type is the lack of any material to withstand speed change ranges over the ranges as required in a wire handling system of this type. Running at a definite speed with say a 36″

reel with 18" diameter barrel, the diameter change ratio is approximately 2 to 1. Despite the application of dressings or the use of other materials than leather friction precludes a satisfactory operating range of more than 15 per cent. This same argument applies to the general design of friction clutches that are now on the market; wooden faced or metallic faced clutches soon wear in and glaze; thereby upsetting the entire co-efficient of friction used in the basic design of the equipment. The result is then that the tension adjustment is screwed down to its greatest point and there it remains. At this point the belt or clutch no longer slips and the wire speed varies in proportion to the entire diameter buildup. With the tendency of the diameters to build up there is an increase in wire tension from the outlet side of the capstan. Usually, if the belt adjustment is screwed down too tightly, there is an excellent chance that the wire may be pulled ahead of the capstan or the wire may be stretched to an elongation point. If it is small diameter wire the danger of stretch is greatest and at high speeds it may even result in actual breakage of the wire. In a wire lacquering system handling only two or three individual strands a conscientious operator might keep the tension within safe limits by carefully watching the manual tension adjustment. In a modern high speed system running eight to ten strands at high speeds it is impossible for one operator to maintain manual tension adjustment on the reel.

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THIS general system might be classed as feasible (but not efficient) for a small class of heavier wire and cable where few coats are applied or where the specifications to be met are lax as to finish or dielectric strength.

✦ ✦ ✦

Friction Unwind—Friction Windup with Direct Slip Belt Drive

ANOTHER type of system not often encountered is shown in Figure No. 5. This system has quite a number of inherent faults, but only due to the fact that some manufacturers are still using this type of equipment it is being mentioned.

✦ ✦ ✦

BASICALLY, it embodies a tension braked payoff reel stand, tower sheave system and with a very simple windup stand arranged so that the wire is wound directly on the reel. The reel is driven by a tension adjustment slip belt on a friction type pulley.

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THIS particular style of system does not lend itself at all to high speed production or to production where the reel diameter buildup is a factor. Its inherent disadvantages are first of all lack of any positive speed control, which only results in variable speeds and pulsations or jerks in the wire as it passes through the lacquer pot.

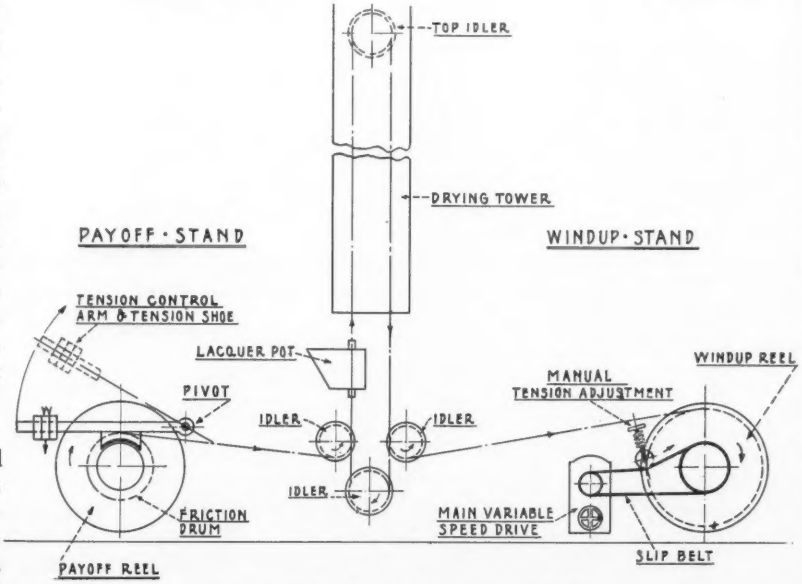

Fig. 5. Friction Unwind; Friction Windup with Slip Belt Wire Drive.

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FROM an equipment standpoint it consists of a main variable speed drive unit, which drives directly to the reel shaft by means of a slip belt equipped with manual tension adjustment. In a system of this type no capstan or positive wire drive is used and the torque exerted by the slip belt on the reel shaft is used to pull the wire directly.

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IF one would consider the speed requirements in a wire drive of this type, it would be seen how unsatisfactory it is. Assuming a reel barrel diameter of 14" and a wire production range of 50 to 200 F.P.M., and a maximum reel diameter of 34"; a speed adjustment of 5.5 RPM Minimum to 54.5 RPM Maximum is encountered. The slip characteristics of the belt would have to vary over this entire range easily and without change of characteristic. Theoretically, on starting up the slip is very great and the tension adjustment loose. As the diameter increases the slip requirements are proportionately lengthened and the tension adjustments are proportionately greater. It is impossible manually to continuously adjust the tension adjustment with each successive wrap of cable to maintain constant wire speed. If the speed is not constant the tension is not constant, resulting in an uneven speed of the wire through the pot as well as undue stress in the wire itself.

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SUCH simple systems have sometimes been used on one and two coat jobs on heavy cable, but their use is not satisfactory or economical for high speed or accurate specification wire.

(Please turn to Page 358)

Carbide Dies For Steel Shell Cases

By Earl Glen,
Carboloy Company, Inc., Detroit, Michigan.

WITH the conversion from brass to steel for shell cases ranging from 20 mm. up to 90 and 105 mm., the use of cemented carbide drawing dies has now become standard accepted practice. Carbide dies were of course being extensively used for drawing brass cases due to their longer life and lower cost per piece produced. However, with the advent of steel shell cases, carbide dies became a necessity.

✦ ✦ ✦

IT is almost impossible to obtain reasonable steel case production without cemented carbide drawing dies. Conversely, therefore, the intensive and extensive development of carbide drawing dies has made possible the substitution of steel for brass, with attendant large scale conservation and critical materials, particularly copper. According to U. S. Army Ordnance, the saving on a single contract for 105 mm. shell totals 12,600 tons of critical brass, as an example.

✦ ✦ ✦

THE conversion from brass to steel did not present any unusual die manufacturing problems since the carbide dies used do not differ a great deal fundamentally from carbide dies used in drawing steel tubing. They have been used for such purposes for several years with great success and cemented carbide dies have become practically standard for this type of work.

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PRIME difference between most shell case drawing dies and steel tube draw dies is the provision of a guide ring plate on the former to guide the case into the die. When drawing steel tubing, the end of the tube is pointed so as to feed readily into the die without requiring a guide. In some instances of shell case drawing, moreover, rotary indexing tables are used, eliminating need for the guide ring.

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AS with any new application of a product, minor service difficulties are to be expected if the user is not acquainted with the characteristics of carbide dies and the proper scheduling and procedure for die maintenance. This is particularly important in view of the fact that quite a few organizations now switching to carbide dies for shell case drawing have had little or no experience with carbides in the past.

✦ ✦ ✦

Service Requirements

IT is absolutely essential that large-scale users of carbide dies as for shell or case drawing be in a position to service and re-cut such dies. Carbide dies will produce several times the number of cases between servicing operations that are possible with dies of other materials. It is however necessary that they be serviced whenever a "wear-ring" appears in the die nib. In order to maintain continuous operation without an excessive stock of dies, which in turn involves the problem of materials conservation, the necessary simple equipment for both polishing and re-cutting of dies should be provided at the point of use. It has been found also that when dies are not serviced by the user, there is a tendency to let them run longer on a job than they should for most satisfactory performance both as to die life and continuous production quality.

ONE reason for this is an innate characteristic of all carbide materials. A shell case, when it enters the die, presents a relatively sharp edge at the O. D. where it first contacts the die approach angle. After a period of time, a fine, very small "ring" is formed at this point of contact. As soon as this ring forms, the die should be re-polished to remove it. If not, fine particles of carbide will gradually begin to break out resulting in a fairly rapid increase in die wear at this point until the surface at the ring becomes so rough as to cause pickup and even scoring of the bearing.

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THE length of time the average die will operate before this ring begins to form varies with the individual installation and also depends to a great extent on the effectiveness with which the case and the die are lubricated. From this standpoint it is highly important to see that the lubricant is carried through the die by the shell case. The most effective means of producing this result is to oxidize the shell case or provide it between draws with a thin rust coating to which the lubricant will adhere. As to the lubricants themselves, a great variety of different types are currently being used and no definite conclusions have been reached as to the most effective type for any given installation.

✦ ✦ ✦

Servicing Intervals

IT is a good practice in drawing shell cases with carbide dies to establish a definite period at the end of which the dies should be removed for polishing. No exact time interval can be given, how-

(*Please turn to Page 356*)

✦ GOVERNMENT WIRE PRODUCTION INFORMATION ✦

Resistors and Fine Wire

MANUFACTURERS of resistors and fine wire, used in military radio, have been urged by the War Production Board to place orders quickly for fine wire.

✦ ✦ ✦

IT was pointed out that while orders for many sizes of fine wire are being delayed, the wire producers are working below capacity, and that facilities for producing some sizes have not been completed so that complaints of slow deliveries may be justified. Those who are experiencing difficulty in the delivery of fine wire .002 or smaller, are urged to seek the direct assistance of the Resources Branch.

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THERE have been complaints from some concerns regarding fine wire deliveries. These complaints may be justified in certain sizes of fine wire where there are definite bottlenecks since some extensions have not been completed. However, there are sizes which are still not up to capacity of production in spite of the fact that these sizes are likewise necessary to meet the requirements of the industry. Apparently some concerns have yet to place orders to meet their requirements in these latter available sizes.

✦ ✦ ✦

IN the event of having placed an order for fine wire (.002 and smaller) and experiencing delivery difficulties, the War Production Board will assist concerns if, with their request, they send a list of all the fine wire orders on which they are having delivery troubles. Report for each order the name of the supplier, purchase order number, size, quantity, description, delivery date promised and date required.

✦ ✦ ✦

Chromium

SMALL deliveries of chromium may be made without War Production Board authorization under an action taken by WPB to simplify administration of Chromium Order M-18-a.

✦ ✦ ✦

SUPPLEMENTARY Order M-18-a-1, effective immediately, permits deliveries of chromium by processors and dealers in quantities of 3,000 pounds or less to a single customer in any one month, provided the material is to be used for metallurgical purposes. The new order also relieves pur-

(*Please turn to Page 344*)

MICROMETER PRECISION MICRO-WELD TRADE MARK REG. U. S. PAT. OFF.

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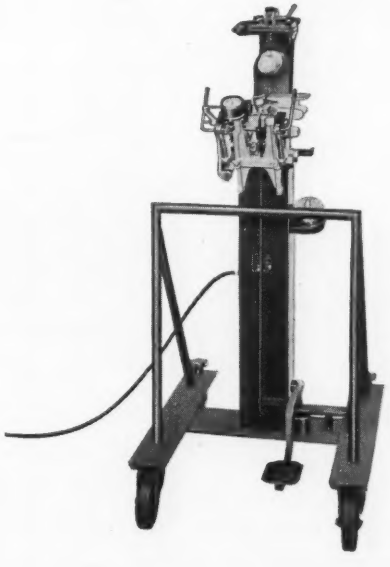
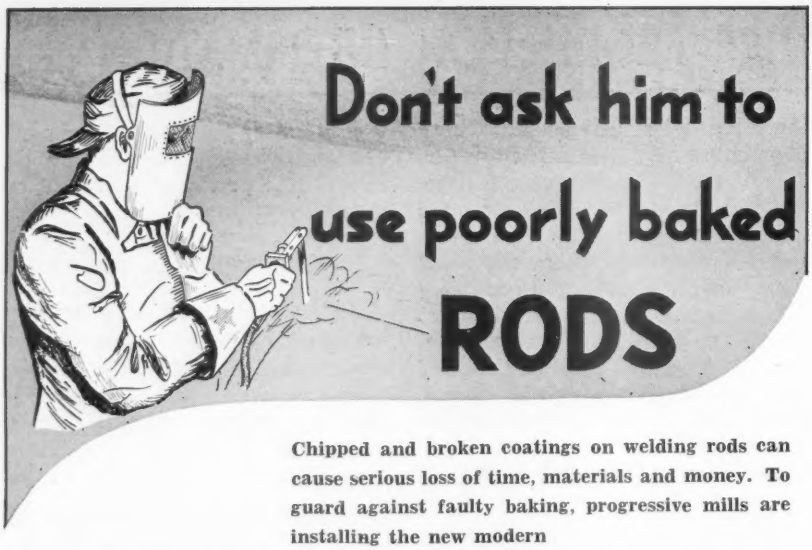
MICRO-WELDERS with dial indicating annealing attachments are now available for high carbon wire.

There is positive control of annealing temperature and already hundreds of these special MICRO-WELDERS are proving their dependability and satisfactory performance with leading manufacturers.



MICRO PRODUCTS COMPANY
20 NORTH WACKER DRIVE, CHICAGO, ILL.
Telephone, State 7468



Don't ask him to use poorly baked RODS

Chipped and broken coatings on welding rods can cause serious loss of time, materials and money. To guard against faulty baking, progressive mills are installing the new modern

ROSS WELDING ROD OVENS

The increasing demand for welding rods has emphasized the importance of the oven used for baking. Ross Multiple Pass, Zone-Controlled, Chain Conveyor Ovens are now standard equipment in the plants of leading rod makers. Ross Ovens handle the rods so as to protect the coatings while they are soft and to apply the heat in different zones without changing the rods from one oven to another.

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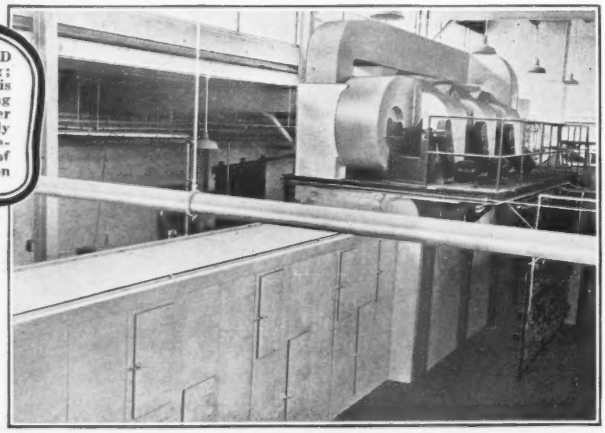

ROSS SYSTEMS

J. O. ROSS ENGINEERING CORP.

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Government Wire Production Information

(*Continued from Page 343*)

chasers of quantities within this limit of the necessity of filing report forms usually required by Order M-18-a. It does not, however, relieve chromium consumers from filing Form WPB-532 with the Bureau of Mines.

✦ ✦ ✦

THE Chromium Section of the Steel Division pointed out that shipments within this limit amount to only eight-tenths of one per cent of the total chromium shipped each month.

✦ ✦ ✦

ATTENTION was called to the fact that Supplementary Order M-18-a-1 makes no changes in the restrictions on the melting of chromium. All deliveries of the metal, including those covered by the Supplementary Order, are subject to the restrictions of Order M-18-a with respect to melting.

✦ ✦ ✦

Small-Diamond Dies

SMALL-DIAMOND dies, size .0015 and under, are being produced now at a rate in excess of current consumption and the nation's stockpile of these dies is slowly increasing.

✦ ✦ ✦

THERE is no substitute for the small-diamond die, formerly produced only in Europe, in the drawing of wires of spider-web fineness that are essential in the production of military radio and radar.

✦ ✦ ✦

THE previously anticipated great increase in demand has not yet materialized, but production and employee-training are being stepped up to take care of expanding requirements. There has been an increase in demand for a somewhat larger small-diamond die, the .002 size, which certain wire manufacturers could not locate. Such dies are available or can be made available as they are required.

THE quality of the dies made in the United States, now the sole source of new supply, is reported by wire manufacturers as continuing to improve. Greater yields of wire per die are being recorded.

✦ ✦ ✦

AMONG other matters discussed were suitable settings for the inspection of small dies, and progress was reported in the development of new methods of setting the dies so as to withstand heat processes and, at the same time, permit power inspection of mounted die-stones.

✦ ✦ ✦

H. W. JENNRICH, of the War Manpower Commission's Apprentice Training Service, told committee members that the training programs in the operations of small-diamond die making are difficult to put into operation because of the exacting occupation involved. Nevertheless, he pointed out, through the cooperation of some of the Fort Wayne, Indiana producers, the program has proved feasible. Production has doubled and trebled since the start of training.

✦ ✦ ✦

A DIAMOND Die Research Laboratory is now operated at the Bureau of Standards as a project of the War Production Board's Office of Production Research and Development. **Drs. C. G. Peters** and **Herbert Insley,** scientists engaged in the research project, told the meeting of the work being done on wires and dies to determine diamond die quality to improve the quality and production methods. A completely equipped laboratory and work shop have been provided.

✦ ✦ ✦

DIES, wire and records of wire poundage now being made, are submitted by industry. In addition to scientific measuring, testing and microphotographic recording, simulation of industry operations in wire drawing and die production are being conducted at the Bureau.

Helping Speed VICTORY SHIPS "down the Ways"

KEYSTONE Wire

Husky wire cables slung from giant cranes lay the first keel plates of the Victory ships. Other heavy duty cables "snub" the momentum of the rapidly completed ships as they slide down the ways. And between these stages literally miles of wire cable carry plates, fittings and sub-assemblies to the right spots, in a hurry.

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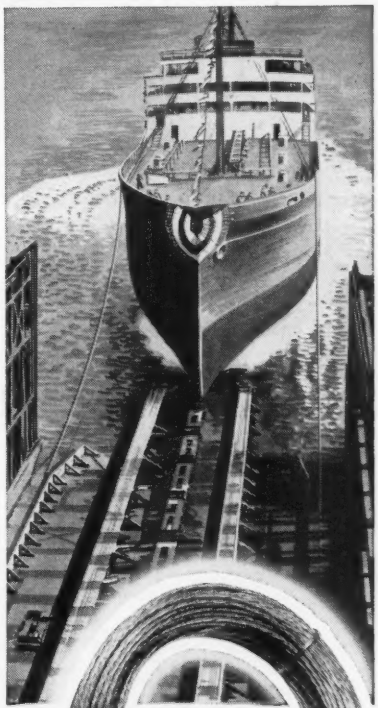
Keystone wire and rods for *civilian* products must come *second* to these demands—until Victory.



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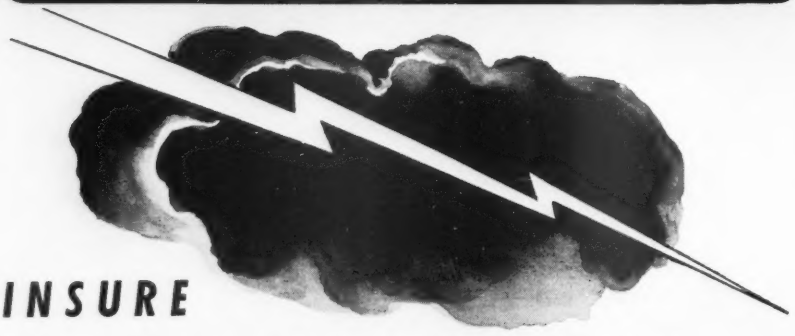

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For drawing zinc-coated wire dry. Also used for dry ripper hole on wet wire drawing of zinc-coated wire. Order extra fine grind. This compound puts a metallic coating on the wire.

#48

A lower melting point soap for the drawing of high carbon rod or wire. Use this material in extra fine grind.

#1

For low carbon wire, on either machines or benches. Also the drawing of processed wire, and producing common finishes. For the drawing of rods use medium grind, and for processed wire, use fine grind.

#40

For drawing low or intermediate carbon wire. For low carbon wire use medium grind, and for intermediate carbons use fine grind.

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Industrial Incentives

By Rear Admiral C. H. Woodward, USN, (Ret'd), Chief of the Industrial Incentive Division Navy Department

EFFICIENT production of ships, planes, guns, weapons and other products for the Fleet is not solely a matter of materials, machinery and engineering methods. It also involves human factors, personnel policies, and the use of industrial incentives. Workers, and their relationship with each other and with management, require as much attention and inspection as the material and machines with which they work.

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THROUGH the proper use of industrial incentives, much can be done to reduce absenteeism, work spoilage, rejects, waste, general disinterest toward the job, shifting and pirating of labor, and other major personnel and morale problems. Properly designed industrial incentive plans can, likewise, increase the output of work per man, and can stimulate the making of valuable suggestions for improving production methods and techniques.

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WHILE wages may possibly be the most important single factor in a worker's judgement of his job, wages alone are not sufficient to hold him and stimulate his best efforts. There are other incentives which make an appeal that money cannot make. Certain non-financial incentives must be added to wages in order to draw the best out of a man.

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NON-FINANCIAL incentives are the appeals which may be made to a man's patriotism, his desire for fair play, his appreciation of desirable surroundings, his confidence in those above him, his loyalty, his sense of duty, his desire for achievement, his competitive spirit, his desire for a good reputation, his ambition for promotion, his creative impulses, his desire for self-development and his instinct for self-preservation. The proper appeal to those motives in a working-man can be made just as effective as any money appeal.

NOW that our country is at war, an appeal to a worker's patriotism is a powerful incentive. If the worker realizes that he and the job he is doing are important in the war program, he will do better work and more of it.

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LABOR and management representatives should, therefore, jointly consider ways and means of installing incentive plans to combat any major personnel and morale problems which are retarding production.

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FOR example, in appealing to a worker's competitive spirit, through the use of contests to reduce the amount of absenteeism, work spoilage, and industrial accidents, or to increase output, the widest continuous publicity should be given in order to enlist the widest participation in these contests. Plant magazines, posters, scoreboards, bulletin boards, radio, labor press, daily press, plant rallies, and competitions for appropriate prizes to be awarded by management for the best individual, gang, department, and plant records should be utilized to the utmost, but actual production figures should not be revealed. Some unit system of measure should be devised that would **not** be an index to actual production rates and figures. Nor should rates of production be made available to news outlets without proper clearance.

✦ ✦ ✦

Blackening Processes for Metals

THE Enthone Company has just released two new folders describing "Ebanol," a product made in four different varieties for applying protective black coatings to iron, steel, copper, brass, zinc and aluminum. The non-ferrous blackening agent, is used for grommets, shell casings, aerial wire, measuring instruments, fittings, screws, radio parts, wire and so forth. The folders give operating instructions, describe the advantages and limitations of the blackening salts, and give technical data on various results secured.

✦ ✦ ✦

AS these products already have wide present applications in many phases of our war production, they should be of interest to a large number of our readers. The booklets may be secured by writing **The Enthone Company,** 444 Elm Street. New Haven, Conn.

✦ ✦ ✦

John W. Haddock, Elected President of Farrel-Birmingham Company, Inc.

FARREL - BIRMINGHAM Company, Inc., of Ansonia, Conn., and Buffalo, N. Y., announces the election of **John Wolcott Haddock** as president of the company. He assumed his new duties on May 1.

✦ ✦ ✦

MR. HADDOCK was formerly Vice President of the Sullivan Machinery Company of Claremont, N. H., and Michigan City, Ind.

Announcement to

★

PRODUCERS and LARGE USERS of WELDING RODS

The First Complete Welding Rod Processing Plant Ever Assembled Under One Roof For Demonstration Will Be Shown At Cleveland, Ohio Early in June.

★ This plant, complete from wire cutting and feeding machine to final inspection, weighing and packing, will be completely assembled in production line and will be in operation, actually processing welding rods. It is one of a number we have sold to a foreign power. More are under construction, and we should like all foreign purchasing commission officials, welding engineers and manufacturers interested in an operation of this scope to see this plant while it is in operation.

INSPECTION BY APPOINTMENT ONLY
PLEASE WRITE OR WIRE AT ONCE FOR RESERVATION

Ernest P. Moslo

MOSLO MACHINERY COMPANY
Engineers and Builders
2443 Prospect Ave. · Cleveland, Ohio

New Type Stitching Wire

A FORM of the ancient art of sewing has resulted in time-savings by unskilled labor of as high as 90% in the production of various sub-assemblies going into America's war-planes. This revolutionary procedure is the result of a new-type stitching wire developed by the American Steel & Wire Co., subsidiary of United States Steel Corp.

THE wire permits the stitching or binding of various types of materials much as pieces of paper are stapled together by an ordinary desk stapler. It is particularly adaptable to the fastening of rubber, plastics, fibre board, laminated wood and other construction materials to stainless steel or aluminum. Its use permits stitches to be made at the rate of several hundred per minute and already remarkable savings of time have been made by several leading aircraft manufacturers in the fabrication of non-stressed parts and in the application of rubber sealing to hatch doors, landing gear doors and similar parts. Heating ducts and shrouds can be lined with asbestos and a tight bond furnished between the asbestos and material by use of these stitches. Cold air ducts, first aid kits and ammunition boxes also can be "sewed" into their proper places by use of the material.

✦ ✦ ✦

THE new stitching wire is of a special analysis and was perfected only after many months of painstaking research and development by American Steel & Wire Co. specialists. It has a guaranteed minimum tensile strength of 290,000 lbs. per square inch. It has a zinc coating which withstands a salt spray for a period of several hundred hours, in accordance with Army Air Corps specifications. Rigid specifications permit very little tolerance from the required .051" diameter, which is approximately that of a lead in a mechanical pencil. The wire will penetrate stainless steel of .030" thickness, duralumin of .040" thickness or aluminum of .060" thickness. Other softer materials such as rubber, wood, asbestos, cork, etc., can be penetrated to a thickness of ¾".

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Redesigned Cable Coupler Saves Material; Speeds Production

BY redesigning the cable couplers for a piece of war equipment in quantity production at General Electric, **Walter W. Brown,** engineer of the Company's Transportation Department, eliminated a bottleneck and paved the way for savings of tons of critical materials.

✦ ✦ ✦

ON the basis of current orders for the equipment, savings amount to 8900 lb. of brass rod; 21,500 lb. of phosphor bronze (which contains 18 to 20 per cent of tin); and 120,000 lbs. of aluminum—all remarkable quantities considering that only one of the coupler parts redesigned weighed more than a few ounces.

SAVE ZINC

Save scarce metal and cut down waste in your hot galvanizing of wire and pipe by using

DEWALCO LIQUID BLANKET

★ PREVENTS FORMATION OF ZINC OXIDE

★ CUTS HEAT LOSSES

★ REDUCES DROSS

Successful use for more than a year has proved its worth. We don't claim it will produce the same results in every operation, but its record of achievement indicates that it may help you. Isn't it worth a serious trial to see what it will do for you? We'll gladly give you details.

SAVE ZINC — USE DEWALCO LIQUID BLANKET

DEWEY AND ALMY CHEMICAL COMPANY • CAMBRIDGE, MASS.

ADDING to the merit of the accomplishment is the fact that strict interchangeability of component parts was maintained without changing the type or form of the couplers or any of their catalogue numbers. Thus, supply parts ordered from existing catalogues will fit couplers already in the field.

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THE new design simplified the manufacture of the couplers. Originally an aluminum die-casting, the coupler bodies are now made from steel tubing and punchings formed to shape. This change eliminated the need for machining, an operation which was becoming a bottleneck. Transferring the job to the punch-press department speeded production 50 per cent.

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DRAWING the tubing to the required shape was the most difficult problem in the design change. The type of draw had not been used in any previous manufacturing operations for these couplers, and considerable tooling and development were required to develop the dies needed.

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SWAGING has replaced the machining operations formerly required for almost all parts of the couplers. For example:

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A SOCKET made from 1-inch diameter hard brass stock turned down to 3/16-inch is now made from 13/16-inch diameter the sleeves, resulting in material saving of 35 per cent.

✦ ✦ ✦

A PLUG was formerly made from 1-inch diameter bronze bar stock. It is now made from 5/8-inch diameter bar with the sleeve swaged on, resulting in a 61 per cent saving in bronze. Another plug formerly made from 1-inch diameter bronze is now made from two swaged parts with a saving of 32 per cent in material. Using the same process for a socket previously made from 1-inch diameter hard brass cut the amount of brass required 35 per cent.

✦ ✦ ✦

STILL another plug made from 1/4-inch bronze turned down is now made from 3/16-inch diameter bar with a 1/4-inch square collar swaged in place. This effected a material saving of 65 per cent.

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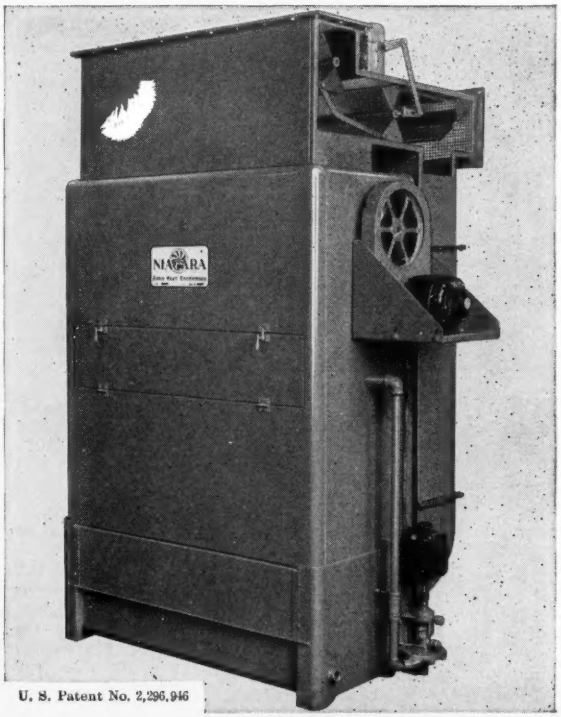
A FOURTH plug made from 5/16-inch square bronze turned down is now made from 1/4-inch diameter bar with a 5/16-inch square collar swaged into place, obtaining a 50 per cent saving in material.

✦ ✦ ✦

Carl King, Gen. Supt., Palmer Works, Wickwire Spencer Steel Company

CARL KING has been made general superintendent of Wickwire Spencer Steel Co., Palmer, Mass., plant, and **F. G. Lindstrom,** superintendent of manufacturing operation.



U. S. Patent No. 2,296,946

IMPROVE PRODUCTION!

● **The NIAGARA AERO HEAT EXCHANGER maintains ideal temperature control constantly.**

For wire drawing compounds — water, oils, or solutions used in any industrial liquid cooling, its improved performance prevents losses or rejections and increases production speed and quality.

The Niagara Aero Heat Exchanger is economical to install and saves expense—replacing both shell-and-tube heat exchanger and cooling tower, reducing pumping, piping and size of tanks. It saves nearly all cooling water, using air instead, by the evaporative cooling principle. It provides for heating as well as cooling.

Write for Niagara Bulletins 90 and 94—and information on users' experiences. Address Dept. WP-63

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NIAGARA INDUSTRIAL COOLING • HEATING • DRYING HUMIDIFYING • AIR ENGINEERING EQUIPMENT

Some Effects of the War On Mechanical Spring Design and Inspection

(*Continued from Page 334*)

tire inspection operation, the ground surfaces and immediately adjacent areas of the end coils were completely invisible. Seams have no respect for end coils; in fact they have a bad habit of occurring in just that region, where they are most difficult to find. The principle of being able to view the spring from any desired angle was violated by holding it fixed between the electrodes, so that it could only be rotated on its axis. Red powder was being used on surfaces whose color varied from blue to brown, giving very poor contrast. The spring, if not too hot, was getting uncomfortably close to the safe limit. And finally, the oil suspending the powder was being continuously pumped over the spring from a hose nozzle held by the operator. This created an oil film on the spring, giving such confusing highlights from the light source being used that even an obvious defect might well have gone unnoticed.

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THE wet residual method has been successfully used for the inspection of valve springs by some engine manufacturers. However, published technical data comparing the sensitivities of the various methods of magnafluxing show little to choose between wet or dry application of powder for the detection of surface defects.

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THE inspection of oddly shaped parts is another interesting phase of magnaflux operations. It might be worth mentioning briefly as an example of the importance of using the proper method of magnetization in obtaining reliable results.

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MAGNAFLUXING is based upon the interruption of a magnetic field creating localized, unlike poles. These poles attract the ferromagnetic powder to the vicinity of the field break. For maximum effectiveness this break should be at right angles to the flux lines of the field. The creation of a field with flux lines running at right angles to the expected type of defect is then the criterion of proper magnetizing. For application where the defects are apt to run longitudinally in the material, a circular field created by passing the current longitudinally through the material is most satisfactory. It has been found impossible to successfully magnetize coil springs by induction because the flux lines then run longitudinally through the wire. This creates very strong poles at both ends of the spring, making it virtually a bar magnet. Powder placed on a spring so magnetized tends to gather at these poles. It builds up in groups of radial fingers which cover the end coils obscuring any defects which might be present, while the field in the body of the spring is not strong enough to make the powder adhere to the wire.

2 BX Mossberg Carrier

MOSSPEED BRAIDER CARRIERS

Represent

Improved Braiding at Lower Costs

The patented MOSSPEED spring tension take-up makes it possible to increase the speed of the maypole-type braiding machine. An effective increase of 80% being obtained in many cases.

The new (x) type MOSSPEED high speed carrier permits the rapid changing of tension springs making this an ideal carrier for braiding all kinds of yarn (cotton, rayon, asbestos, jute), in addition to fine strands of copper wire.

Consult our engineers regarding your braiding problems.

2 SE Copholder

Complete line of both MOSSPEED carriers and metal copholders for all sizes and makes of maypole type braiding machines.

MOSSBERG Pressed Steel Corp.

18 West Street

Attleboro, Massachusetts, U. S. A.

Ross Whitehead & Co., Ltd., Montreal and Toronto, Canada.

James Day (Machinery), Ltd., "Ford House," 88 Regent Street, London, W. I., England.

FLAT continous washers, such as the Belleville type, may be magnetized by placing a rod carrying current through the hole in the washer. This induces a circular field in the washer which shows up radial cracks very well. There also appears to be enough variations in field direction to show up cracks concentric with the diameter of the washer. Attempts to magnetize open end washers or wire snap rings with this method will not be successful. It was some time before the inadequacy of induction magnetizing for this type of work was fully appreciated. Magnetizing these parts by induction as described above, or by stacking them and passing current from one end of the stack to the other, only produces a field which makes each snap ring a miniature horseshoe magnet. The same results are obtained when the powder is applied as with the coil spring magnetized by induction. The only defect this method will reveal is a bad transverse crack on the body of the ring. This type of defect very seldom occurs in these parts. The strong poles on the ends of the part group the powder, so that any cracks near the ends cannot be seen.

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SUCH rings must be magnetized by passing the current longitudinally through the material of each individual ring in a manner somewhat similar to that of magnetizing coil springs. After failure of the other methods of magnetizing to reveal defects which were obvious upon coarse etching a part, the above method was worked out and has given satisfactory results.

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CONSIDERABLE could be written on the subject of finish and the relative merits of various polishing and burring operations. The beneficial effect of many of these operations on the actual quality of a properly designed part is open to question. However, this subject is a very controversial one, and would lead to a lengthy discussion of design. We will suffice it to say that a great many of these operations are being carried out and that, for better or worse, they are creating a product with an appearance of craftsmanship unthought of in previous commercial work.

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IN the inspection of protective coatings cadmium plating is probably the most important single item to be considered. Although much work has been done in efforts to develop other satisfactory means of protecting carbon steel springs from various types of corrosion, cadmium plating is still the most effective for most applications. It is still the most widely used corrosion resistant coating for springs.

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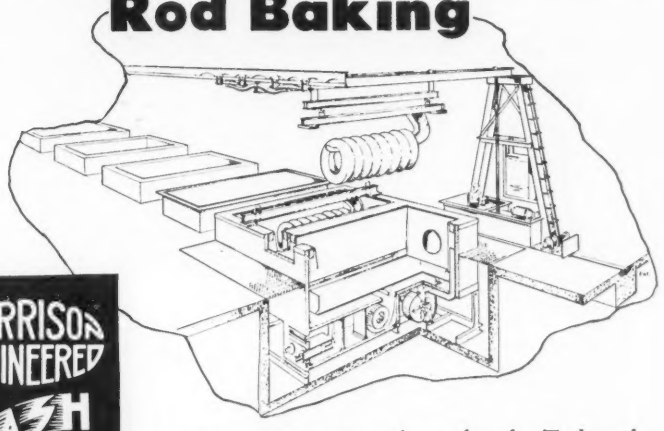
THE cadmium plating of springs to government specifications has been a difficult task due to the attitude toward the appearance of the plating. Behind this has been some lack of understanding of what is and what is not a satisfactory corrosion resisting plate. A crow-like belief that any cadmium plating that glitters is good, and all that does not should be rejected,

(*Please turn to Page 352*)

This Sketch Revolutionized Rod Baking



MORRISON ENGINEERED FLASH BAKERS

These advantages can mean much to your wartime production schedules

SAVE SPACE

RUST-FREE ROD

HIGH CAPACITY

HIGH RECOVERY FROM BRITTLENESS

SHORT BAKING TIME

Seven years ago—only a sketch. Today the equipment based on this idea is baking rod in 6 minutes. Compare this with 3-hours, the former average baking time established by a survey of 24 rod-baking mills.

Forty-seven Morrison Flash Bakers are now in operation in 27 plants—saving millions of hours and speeding the production of war-needed rod products.

This equipment fits into straight or circular cleaning-house set-ups—occupies the space of one tank. Rod never leaves the hook—saving labor and speeding production.

Literature telling how Morrison Flash Bakers will increase your output, cut your costs and improve the quality of your products will be mailed on request.

Ask for Descriptive Literature

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Some Effects of the War On Mechanical Spring Design and Inspection

(*Continued from Page 351*)

has unduly complicated the matter of obtaining approval of plated parts. This, coupled with the fact that coil springs, wire forms, and intricately shaped flat parts of high carbon steel are a most difficult plating problem, has occasioned much lost time and many delayed deliveries.

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CADMIUM plating is purely functional so far as springs are concerned. Its desired appearance should not be confused with the ornamental chromium plating found on automobile radiator grilles. It is true that nearly all cadmium plate specifications contain a bright finish clause, but the basic reason for this clause is to insure a reasonable looking surface, as free from blistering as possible. It can truthfully be said that the color of sound cadmium plating has little if any effect on its corrosion resistant properties. This has been demonstrated by competent authorities on electroplating in regard to the effects of oxide stains from the chromic acid rinse. It is further borne out by the fact that some very competent engineers insist that all cadmium plated parts they use requiring heating to relieve hydrogen embrittlement show a yellow or brownish color after heating. They do this merely to furnish themselves with positive evidence that the parts have had the proper heat treatment.

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THE difficulty of plating springs is not caused so much by the technical obstacles of the plating operation as by the difficulty of finding a satisfactory method of properly cleaning easily distorted parts. Since acid cannot be used for cleaning high carbon steel springs other methods must be found.

IT is true that occasionally the appearance of a cadmium plated spring will do anything but inspire confidence in the quality of the plate; even though it meets salt spray tests satisfactorily. The necessity for improving the appearance has led to considerable effort. It must be admitted that this has helped develop a better understanding of the factors affecting the quality of the cadmium plate, including color and smoothness, as it is applied to spring use. In general it can be said that the finish of the plating will be as good as the cleaning operation preceding plating and no better. This applies especially to blistering and is extremely important. Bad blistering does have a detrimental effect on corrosion resistance.

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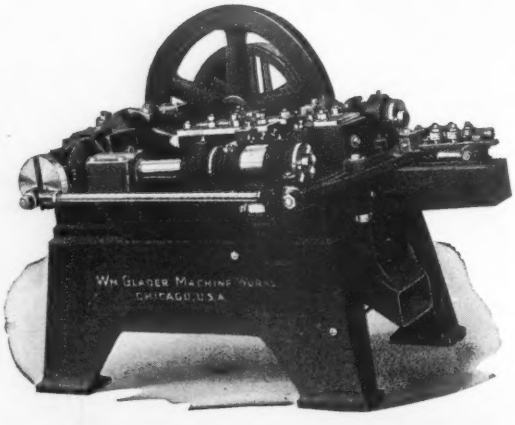
IN discussing these various phases of spring design and inspection, considerable emphasis has been given to their relationship with government specifications and inspectors. As previously



Steel frame high speed wire nail machines. Built in eleven different sizes and types to cover efficiently the making of nails from the small brads to the 12″ spikes.

Write for catalog and production table.

WM. GLADER MACHINE WORKS

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mentioned the intention of so doing was not that of destructive criticism, but that of pointing out a few fundamental principles. Principles which, if understood by all concerned, would be of mutual advantage to both the government and the manufacturers. Some of the ideas expressed herein have been discussed at some length with government men with whom the writer has had extensive and pleasant association in working on many of these problems. These men fully realize the importance and magnitude of the difficulties involved.

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THESE problems represent those of one highly specialized industry, and are multiplied many times throughout the whole of industry itself. The government inspector is now practically an integral part of our industrial machine, and will undoubtedly remain so for the duration of the war. As an integral part of industry, his decisions are of vital importance to the government and the manufacturer alike. His position involves much responsibility, and with that must go the willingness to accept criticism of methods and frank discussions of problems mutual to his work and that of the manufacturer. It is only by such discussion, rather than by behind-the-door criticism, that these problems can be brought to light and better methods for their solution developed.

✦ ✦ ✦

Booklet On Pickling

A BOOKLET entitled, "Modern Pickling of Iron and Steel," has been prepared for concerns having pickling problems by the **Enthone Company.**

✦ ✦ ✦

THIS book discusses the theory of pickling, stability in acids, surface tension reduction, fumes during pickling, saving of acid and hydrogen embrittlement. It then goes on to treat of pickling agents for various purposes, as the removal of rust and scale, pickling of springs and spring steel, pickling before plating, hot galvanizing and tinning, electrolytic pickling and stripping heavy chromium from steel. The pamphlet contains much valuable information that persons dealing with these problems should have, and will be sent to anyone interested by addressing the Company at 444 Elm Street, New Haven, Conn.

✦ ✦ ✦

Booklet Describes Protective Coatings

A NEW pamphlet describing a line of protective coatings for metal surfaces, floors, paper tanks, furnaces, and other places subject to corrosion or deterioration from air, water, acids and heat, has just been released. It is entitled "The Tocol Line." Persons desiring a copy of this may secure it by addressing a request to **Protective Coatings, Inc.,** P. O. Box 56W, Strathmoor Station, Detroit, Michigan.

No Trick at All . . .

for

TECO CARBIDE DIES

KEEPING wire production at peak without suffering let-downs in accuracy and finish is a job your machines will do better when they're equipped with TECO Carbide Dies.

The high-speed, long-run capacity of TECO Carbide Dies produces more tonnage per machine, more tonnage per man-hour — every pound of production of the highest quality, held to accurate tolerances and unblemished finish.

To give this superior performance, TECO Carbides are held to rigid standards of uniformity, density and hardness through every step of manufacture. It will pay you to make a test run with TECO Carbide dies. Our engineers will gladly discuss your needs.

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WIRE and BAR DIES
EXTRUDING DIES
TUBING DIES
SIZING DIES

TECO Pioneers in Tungsten Carbides for over a Quarter Century **CARBIDE DIES**

A Review of Recent Wire Patents

No. 2,315,543, SPRING STRUCTURE, patented April 6, 1943 by James Piliero, Long Island City, and Nathan Goldberg, New York, N. Y., assignors, by mesne assignments, to Dickson Wire & Cable Corporation, Long Island City, N. Y., a corporation of New York.

Plate-like connectors are provided for tying the coil springs to sets of cables extending between certain of the rows of coil springs.

✦ ✦ ✦

No. 2,315,568, CLEANING STEEL SURFACES, patented April 6, 1943 by Christian J. Wernlund, Niagara Falls, N. Y., assignor to E. I. du Pont de Nemours & Company, Wilmington, Del., a corporation of Delaware.

This process comprises making the steel, to be cleaned, the anode in an electrolyte consisting essentially of a solution containing sulfocyanide ions in concentration equivalent to at least about 2 ounces per gallon of alkali metal sulfocyanide and thereafter contacting the article with an acid solution which is capable of dissolving iron oxides.

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No. 2,315,736, ELECTRIC CABLE, patented April 6, 1943 by Samuel J. Rosch, Yonkers, N. Y., assignor to Anaconda Wire and Cable Company, New York, N. Y., a corporation of Delaware.

A woven glass covering is applied directly to the surface of lead sheath, so as to reinforce the sheath against pressure from within the sheath.

Complete Descriptions and Drawings of Patents May Be Had for 25 cents. Address, Wire & Wire Products, 300 Main St., Stamford, Conn.

✦ ✦ ✦

No. 2,316,293, ELECTRIC POWER CABLE, patented April 13, 1943 by Thomas Robertson Scott, London, England, assignor to International Standard Electric Corporation, New York, N. Y.

The wire cable has a coating of tin to protect the conductor against sulphiding, a layer of metal to which rubber will vulcanize surrounding the conductor and this coating, the layer comprising brass coated lead tapes, a layer of insulating material comprising rubber surrounding the layer of metal and vulcanized thereto, whereby formation of any film of gas between this layer of insulating material and the metal is prevented.

✦ ✦ ✦

No. 2,316,572, PROCESS OF FINISHING ELECTRIC CONDUCTORS, patented April 13, 1943 by Irving C. Eaton, Nichols, Conn., assignor to General Electric Company, a corporation of New York.

More specifically the process is in treating the insulating jacket by applying a hot layer of moisture-resisting compound including bituminous material to the jacket, applying a hot layer of flame-retarding compound immediately over this moisture-resisting compound, applying a coating of paint having a water soluble solvent over the flame-retarding compound and then immersing the jacket in a water bath to dry the paint and to cool the layers to prevent blending of these compounds.

✦ ✦ ✦

No. 2,316,984, APPARATUS FOR COATING WIRE, patented April 20, 1943 by William Gould Brockel, Bloomfield, N. J., assignor to Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., a corporation of Pennsylvania.

This apparatus comprises a borax bath, a furnace and a cooler comprising a compressed air manifold having air jet holes so spaced that the cooling air increases in volume from the entering end to the discharge end of the cooler, and a device for drawing wire successively through this bath, furnace and cooler, whereby it is coated, this coating is fused thereon, and the coated wire cooled at an accelerated rate, so that it may then be spooled without injury to the coating.

THE WATSON MACHINE COMPANY
PATERSON, NEW JERSEY, U.S.A.
ELECTRICAL WIRE AND CABLE AND WIRE ROPE MACHINERY

Continuous Takeups — Type "D-C"

For continuous and constant tension reeling at speeds to over 1000 F.P.M.

Widely employed in connection with various extruding processes and products of very low tensile strength.

Pneumatic control system where air at from 30 to 80 P.S.I. is available. Motorized (fractional H.P.) hydraulic system optional.

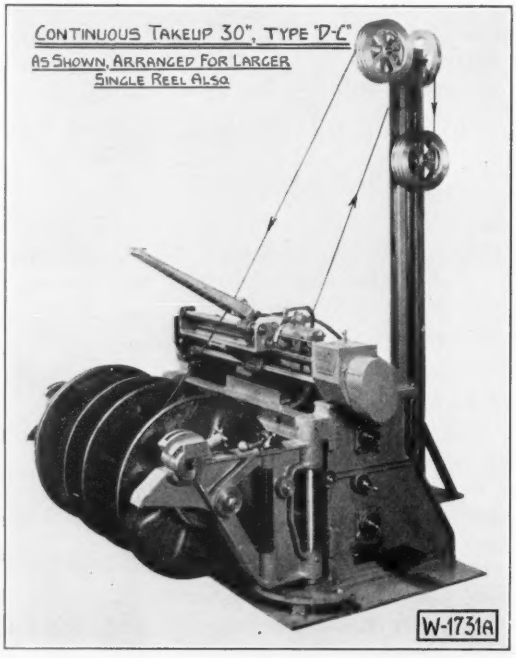
Product transfer at full speed without slow-down.

Rapid reel loading and unloading.

Rugged ball and roller bearing construction for heavy duty.

Suitable for connection to any existing equipment or where present takeup performance is inadequate.

Limited number of units still available for July 1943 delivery.



No. 2,317,247, CUT NAIL MACHINE, patented April 20, 1943 by Bruce N. Bletso, East Cleveland, and George H. Perkins, Cleveland, Ohio, assignors to The American Steel and Wire Company of New Jersey, a corporation of New Jersey.

The nail blanks are sheared at an angle to the center line of the blank, thus causing the nail blanks to taper in width from butt end towards the pointed end. There are 24 claims.

✦ ✦ ✦

No. 2,317,350, COPPER CLAD WIRE AND METHOD OF PREPARING THE SAME, patented April 27, 1943 by Orville E. Adler and Maurice J. Krinowitz, Niles, Mich., assignors to National-Standard Company, a corporation of Michigan.

Upon the iron wire is a copper deposit from a cyanide solution, with a thin layer of acid-deposited copper thereon, next another cyanide solution deposited copper layer and, lastly, a relatively thick layer of acid-deposited copper.

✦ ✦ ✦

No. 2,317,811, COATED METAL WIRE, patented April 27, 1943 by William J. Scheiber, Schenectady, N. Y., assignor to General Electric Company, a corporation of New York.

Copper wire is coated with a semi-glossy black, continuous flexible coating tightly adhering thereto, this coating comprising a superpolyamide modified with a substantial amount but not exceeding 40% by weight thereof of an alkyd resin having an acid number above 50 and being baked on the wire to a partially oxidized and blackened state at a baking speed in excess of the baking speed permissible in baking a wire coating composed entirely of the corresponding superpolyamide under similar conditions to a substantially blackened, and equivalent flexible, tightly adhering state.

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Metal Working in Powder Metallurgy

(*Continued from Page 330*)

tion is the manufacture of ductile, high-purity wire or sheet from fundamentally brittle material — tungsten, tantalum and molybdenum. A laborious scheme of alternate working and annealing of brittle sinter-bars leads to wires spun out to fine, strong filaments with great resistance to shock and creep. This specialized branch of metallurgical engineering is tremendously important and contained in part II is a detailed discussion of industrial methods in the manufacture of refractory metals.

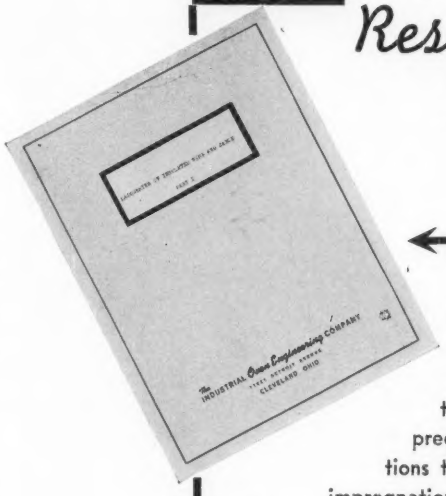
✦ ✦ ✦

IN part III will be discussed experiments on alloys of lower melting points, for the example of refractory metals suggests similar methods. The production of low-melting, ductile metals and alloys of high purity seems feasible by careful control of existing methods. The experiments in part III were on a laboratory scale without commercial consideration of heat treating and working procedures. Since a compromise between ideal processing conditions and industrial possibilities is often necessary, it will have its bearing on the qualities of the resulting product.

Air-Operated Controller

A NEW air-operated automatic control instrument, known as Convertible Free-Vane Controller, as just been announced by The Bristol Company, Waterbury, Connecticut. The new instrument is made for automatically controlling temperature (up to 3600°F.) flow, liquid level, pressure, draft humidity, pH value, and time program, and is offered in on and off throttling, preset, reset, and magniset types.

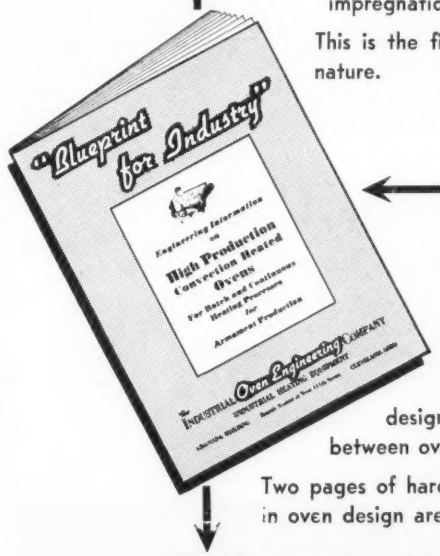
Two "Musts" for Executives, Research & Plant Engineers



Wire & Cable Lacquering

This comprehensive manual covers the technical nature of lacquer impregnation and satisfactory drying conditions that are required to bake it. Pressure impregnation and wire preheating are discussed.

This is the first publication of information of this nature.


"Blueprint for Industry"
Engineering Information on
High Production Convection Heated Ovens
For Batch and Continuous Heating Processes for Armament Production
The INDUSTRIAL Oven Engineering COMPANY

"Blueprint for Industry"

This eighteen page manual covers twenty-eight different types of mechanical oven installations. The design is fully explained and the relationship between oven design and production is explained.

Two pages of hard-to-find engineering information used in oven design are presented for your use.

— WRITE FOR YOUR COPIES ON YOUR LETTERHEAD —

The Industrial Oven Engineering Company

11621 Detroit Ave. **Cleveland, Ohio**

Carbide Dies for Steel Shell Cases

(*Continued from Page 342*)

ever, some companies being able to run three to four days before polishing, while others re-polish their dies every eight hours. Best practice is to watch the operation fairly carefully at the outset and determine the approximate period of time required before the fine ring begins to form.

✦ ✦ ✦

Polishing

THE ring formed in a carbide die when drawing shell cases is much narrower than that experienced in drawing wire or tubing. This is due to the fact that there is more of a line contact between the case and the die than any other forms of steel drawing operations.

✦ ✦ ✦

TO remove the light rings, the major requirement as far as equipment is concerned is the provision of a lathe large enough to handle the dies, a flexible shaft or similar type of hand grinder. To remove the rings a brass rod is placed in the flexible shaft or hand grinder and with this the ring is removed and the surface smoothed out, using a No. 3 diamond powder. The surface is then polished with a felt wheel in the flexible shaft or hand grinder, using No. 5 diamond powder.

✦ ✦ ✦

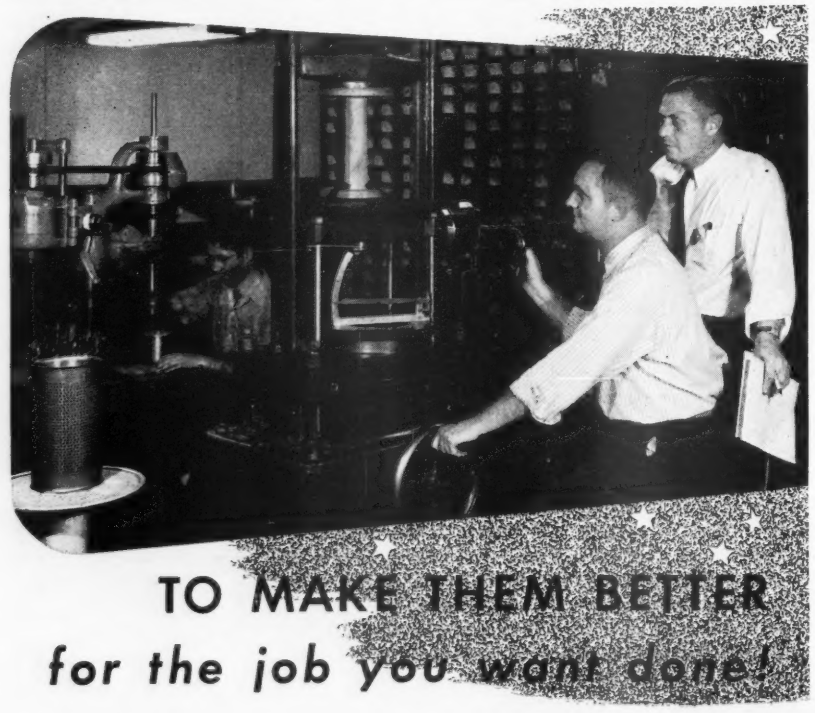
Removing "Pickup"

IN servicing carbide dies it is important that any pickup on the bearing surface of the die be carefully removed. This is particularly true on the final draw die. If pickup is removed with a stone, emery cloth, etc., the die can easily be worn out faster in polishing it than in normal service. The tolerance on the bearing diameter of the final draw die is only 0.002 in. and once this diameter has been exceeded, the die (unless it can be re-cut to a larger draw) will have to be scrapped. On preliminary and intermediate drawing operations, this is not quite as critical, but nevertheless here also it is quite possible to wear the die out faster in servicing it than it does in actual use. Best practice is to cut any pickup off carefully with a sharp scraper and then polish the surface.

✦ ✦ ✦

Die Standardization

AS the result of cooperative study with the Ordnance Division and shell case producers, it has been possible to standardize carbide dies so that a single basic die size can be used for all drawing operations from the first to the final draw on any given type of shell case. As a matter of fact, it is possible to start with a die for the final draw of a 37 mm. shell case, gradually re-cut it as the die wears to the first draw on the 37 mm., and when worn out for this operation, re-cut it to handle successive draws on 40 mm. shell case. Similarly, a single die size can be used for 3-inch anti-aircraft and 105 mm. shell cases. At the present time standardization work is also going on to permit interchangeability of dies between the 75 and 57 mm., shell cases. On the 20 mm. and the 90 mm. shell cases —the two extremes of the range in



Today as always Hubbard research in spool and reel design and construction continues. While now concerning many products for use in the war, the information being gathered is adding to the fund of practical data that guide all Hubbard recommendations and production.

The constant application of those factors determined by Hubbard laboratory research is your assurance that Hubbard spools and reels will continue to be better for the job you want done.

HUBBARD SPOOL COMPANY
1624 CARROLL AVENUE | CHICAGO, ILLINOIS
Since 1912, manufacturers of wire drawing and annealing, and shipping spools and reels.

which steel shell cases are now being produced—one set of dies can also be re-cut for all draws, but the die cannot be re-cut beyond this to handle other sizes of shell cases.

✦ ✦ ✦

Re-cutting

FOR re-cutting of dies, an internal grinder is required. With this and using a 100 grit diamond wheel, the bearing is first re-sized to within 0.001 in. of desired dimension. The approach angle and radii are then re-worked, using the same wheel.

✦ ✦ ✦

THE wheel is now removed and a steel lap inserted in its place and the die is lapped to size, using a diamond powder.

✦ ✦ ✦

FINAL polishing is with a buffing wheel using a fine diamond powder which should always be mixed with olive oil. The buffing wheel should be used on a grinder or flexible shaft with the die mounted in the internal grinder.

✦ ✦ ✦

IN re-cutting, it is also important to re-establish the back relief angle to the correct specification.

✦ ✦ ✦

PROPER die maintenance as to removing of the rings in the approach angle as soon as they begin to form will do much to lengthen the life of a die on any particular operation and will greatly reduce the amount of re-cutting necessary. The more the ring is allowed to wear, the greater will be the pickup and the faster the die will wear as a whole. This is due to the formation of high spots in the approach angle, etc., which cut through the coating on the shell case and cause scoring and pickup.

✦ ✦ ✦

IN addition, proper attention to die maintenance will materially reduce the number of dies required for any given production set-up, an important point in connection with materials conservation, as well as in reducing the necessary die-inventory.

✦ ✦ ✦

Canadian Production of Wire and Wire Products

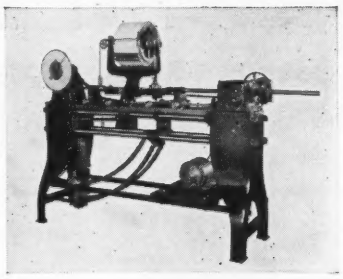
STATISTICS covering 82 Canadian establishments engaged chiefly in drawing iron and steel wire or in fabricating products from wire of iron or steel show factory sales in 1941 valued at $42,395,022. Factory sales were $32,446,893 in 1940, and $25,063,379 in 1939.

✦ ✦ ✦

SALES include plain and galvanized wire, barbed wire, wire fencing, wire nails, tacks, staples, screws, wire cloth, wire rope, bale ties, upholstering springs, and other such commodities.

Facts on File -- a result of Picturized Testing!

Not only do *Scott Testers facilitate research, protect purchasing and speed production, but in addition they provide an invaluable "reference library" of charts. These give a graphic picture of the physical properties of the wire as it reacts to load. The 60 models of *Scott Testers provide capacities for the finest filament wires up to 2,000 lbs. tensile. Describe your needs and we will send suitable descriptive literature.



Model Q-7 Scott Tester. Heavy duty tensile tester for wire, with capacity of 2,000 lbs.

Request Bulletins

HENRY L. SCOTT CO.

55 Blackstone St. **SCOTT TESTERS** Providence, R. I.

*Registered Trademark

Scott Testers — Standard of the World

Lacquering of Insulated Wire and Cable

(*Continued from Page 341*)

Miscellaneous — Other Tension and Speed Varying

ALTHOUGH the four illustrations shown take in the basic types of wire handling systems, there are a few lesser known systems which are being described herein.

✦ ✦ ✦

ONE of the simplest systems of this type, and somewhat the least satisfactory for many reasons is the kind in which the reel is revolved on its flanges on two sets of cast iron rollers. These rollers are positioned in a structural frame, so that the reel sets down between the two sets of rolls. All four rolls are driven. The wire is either wound directly on the reel or the wire is wound up after delivery from a main drive capstan. A system of this type utilizes the co-efficient of friction between the four driven rolls and the outside peripheral surfaces of the reel flanges. All that has been generally said as to the slip belt drive can apply here. The fact that cast iron or steel rollers, slipping or sliding give a narrower slip range than the friction belt makes this system a still less satisfactory one.

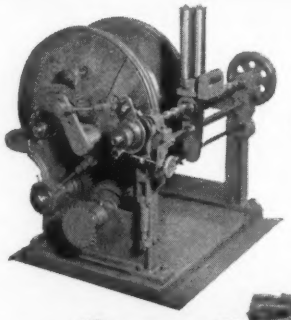
✦ ✦ ✦

SYSTEMS of this particular type are sometimes used in gang type windups and instead of rollers, continuous tubes or pipes are used. Sometimes these pipes or tubes are knurled at the contact points to give a greater frictional co-efficient.

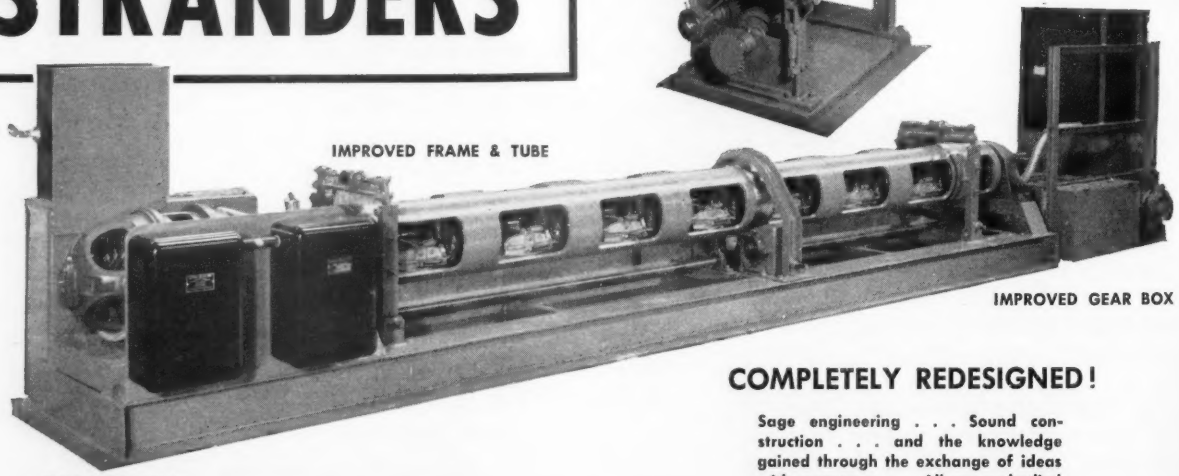
✦ ✦ ✦

ANOTHER system which has found some use, but due to the amount of attendant labor required it is not used very often in wire applications; it consists basically of a vertical arm upon which is mounted a control shaft carrying variable speed variable pitch pulley unit. The upper end of this arm is equipped with a wide faced roller, which in turn rides upon the reel at the barrel. Suitable chain or V-belt drives drive the motor pulley from the output shaft of a suitable reducer, which in turn is driven by an electric motor. In operation the roller at the top of the pivot arm is allowed to contact the work as it is building up on the reel barrel. As the reel diameter builds up the arm is swung outward in such a manner as to vary the belt tension on the motor pulley. As the motor pulley tension increases the split flanges separate and the pitch diameter decreases. As the pitch diameter decreases the windup speed of the reel is decreased. This equipment is mainly limited to more practical use, because of the required amount of attendant labor that is encountered in changing reels. Aside from that, the speed change range in the motor pulley itself is not sufficiently great to take care of more than a limited range of diameter buildups; if the pulley diameter change ratio is great enough to take care of the diameter change ratio it will not take care of any driven speed change decreases.

ROBINSON TUBE-TYPE WIRE STRANDERS



IMPROVED REEL STAND



IMPROVED FRAME & TUBE

IMPROVED GEAR BOX

IMPROVED DRIVE

COMPLETELY REDESIGNED!

Sage engineering . . . Sound construction . . . and the knowledge gained through the exchange of ideas with customers . . . All are embodied in the advanced design and superior operation of the new improved Robinson Wire Strander. Full information available upon inquiry!

ROBINSON MANUFACTURING CO.

WORKS — MUNCY, PENNA.

Sales & Executive Offices 30 CHURCH STREET, NEW YORK, N. Y.

UNIQUE

IN the general statements that have been made in this article on the handling of wire at **constant tension constant speed,** lacquering is the process that has been considered. However, the types of equipment that have been indicated in this article can be very definitely classed as basic, and have many other applications.

✦ ✦ ✦

THE windup stands described in Figure 2 can be used for constant tension constant speed windup of insulated tapes, continuous fabrics, steel strip, coils, shade cloth, and other materials which can be wound up continuously. The same principle may be applied to the windup of freshly extruded wire and cable. Certain minor changes have to be made to accommodate the high speeds and wide speed change ranges that are required in extruding, but nevertheless the same principle directly applies and installations have been made.

✦ ✦ ✦

IN handling of cloths and tapes, such as in the impregnation of varnish cambric, by slightly changing equipment and modifying the float stand so that it really does become an accumulator, the same basic type of equipment can be applied to very high processing speeds. This is true primarily because increment of speed and tension variation are accordingly transmitted in terms of rotary velocity change in the windup reel drum or core.

✦ ✦ ✦

IN the consideration of design for equipment of this type, the Wire Industry has been continuously faced with the lack of information. This condition no longer exists, as equipment is now readily available for the processing of wire and cable at the high production speeds that are necessary for today's conditions. As we all well know, today's demands call for the highest rates of production and the finest quality wire finishes possible.

New Carboloy Catalog

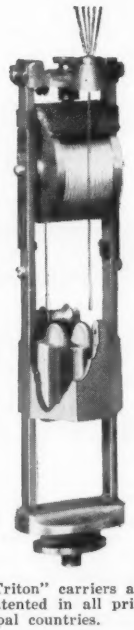
ADAPTED to the requirements of the times, the **Carboloy Company, Inc.,** has issued a new catalog containing much worthwhile information for users of dies for making wire, bar, tubing and sheet metal.

✦ ✦ ✦

THIS provides a complete listing under one cover of standard and special cemented carbide products, containing a list of some 45 new rough cored dies now available. The book contains new technical data, tables of sizes and gauges, and complete listings, illustrated, of die room accessories, supplies and equipment, and is filled with illustrations and data designed to help cemented carbide die users to select and use dies in such manner that increased efficiency will result. The catalog supercedes three previous ones. If a copy is wanted, address your request to the Company at Detroit, Michigan, asking for Catalog D-114.

"TRITON" HIGH CAPACITY WIRE CARRIERS

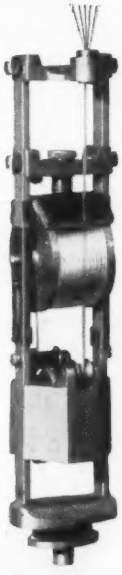
For Precision Hard Wire Braiding, Hydraulic Flexible Tubing, Hose and Electric Cables



"Triton" carriers are patented in all principal countries.

Patented swivel top used on larger sizes.

Braided flexible tubing made with "Triton" carriers.



Note the loose weights supplied in the tension box.

The latest development in wire braiding is our new carrier. Can be used on most braiding machines. New principles increase output without change in running speeds. Perfect control makes for precision braiding at all speeds. Accurately and sturdily made.

Let us quote prices. Send us your horngear size depth and profile of track and number of gears and carriers. Catalog No. 10/4 will give description and specifications of all Carter carriers. We shall be glad to send you a copy.

SOLE MANUFACTURERS

B. & F. Carter & Co., Ltd., Bolton, England

ALBION WORKS • WATERLOO STREET

MACHINERY FOR BRAIDING, TUBING, INSULATING CABLES, ETC.

TYPICAL APPLICATIONS

Tube Attachment to Solid Fitting

Ball and Rod Attachment

Hose & Flexible Tube Fittings

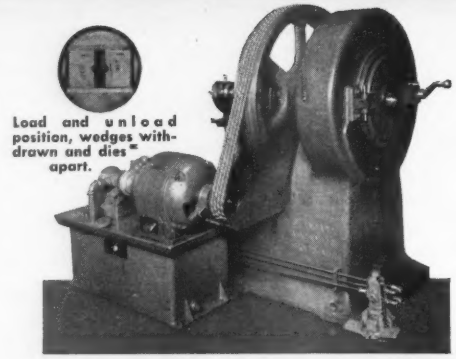
Metal Forms from Solid Bars

Union of Tubes

Cable Attachment and Electrical Terminals

New "STANDARD" HYDRO-FORMER

SHAPES AND JOINS METALS . . WITHOUT CUTTING



Load and unload position, wedges withdrawn and dies apart.

Saves TIME, LABOR, METAL

In one operation, this machine connects tubing or cables to solid fittings, or forms metal sections from solid bars without cutting. A feature of its design is the use of hydraulically-operated wedges to compress the dies so that swaging force is applied at right angles to the work . . . not obliquely as with tapered dies. In reducing outside diameter of tubing, therefore, tendency toward elongation is lessened and thickness of tubing wall is increased. Fittings having large ends can be put into machine without removing dies. This machine simplifies handling of many other operations which previously required more complex, time-consuming methods. Further information on request.

STANDARD MACHINERY CO.

PROVIDENCE RHODE ISLAND

WILLEY'S DIES LAST MUCH LONGER

SIZING, EXTRUSION and WIRE DRAWING DIES

Manufactured in all sizes, to meet your requirements, from a specially developed grade of Tungsten Carbide having freedom from porosity, exceptional abrasion resistance and the ability to take a polish equal to that of diamonds. Furnished in four classifications, (1) blank and rough cored nibs, (2) rough cored dies, (cased), (3) semi-finished, rough drilled dies, (cased), (4) finished dies, ready to use.

WRITE FOR CATALOG

WILLEY'S CARBIDE TOOL CO.

1340 W. Vernor Highway, Detroit, Michigan

General Cable Patents Offered "Royalty Free" to Government For Duration

DWIGHT R. G. PALMER, president of General Cable Corporation, leading independent producer of electrical wires and cables, announces that the use of more than 200 patents held by the corporation has been offered to the U. S. government for the duration of the war on a "royalty free" basis. Numerous types of wire and cable vital to the war effort are covered by the patents, Mr. Palmer said.

✦ ✦ ✦

UNDER terms of the offer, he disclosed, the government may place orders with concerns having suitable manufacturing facilities and capacity whether they are licensees of General Cable or not. In addition, the offer will save the government considerable money on its purchases of vital wiring, since royalty payments on war orders are waived. "General Cable will notify all its licensees that they need no longer continue royalty payments provided the government is given full financial benefit of the savings to the manufacturer," Mr. Palmer said.

✦ ✦ ✦

HE also announced that General Cable is taking steps to eliminate from all of its patent license agreements the corporation's right, wherever it exists, to establish prices, terms and conditions covering the sales of patented wires and cables by its licensees. He added that royalties, wherever they remain payable, will be based on invoiced selling prices exclusive of transportation charges.

✦ ✦ ✦

ALTHOUGH donation of patents and waiving of royalty fees on war work will reduce royalty income formerly devoted to research and development, General Cable is making increased appropriations for research and new products, Mr. Palmer stated.

✦ ✦ ✦

THE decision to suspend royalty payments on war orders was

reached in order to effect savings in price to the Government, and at the same time to encourage opening up new sources to help fill the demands made by modern warfare on the wire industry.

✦ ✦ ✦

New Automatic Temperature Control For Evaporative Heat Exchanger

A NEW method of automatic temperature control for the Aero Heat Exchanger as used for cooling industrial liquids is announced by the Niagara Blower Co., 6 E. 45th St., New York City.

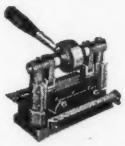
✦ ✦ ✦

THE method is based on controlling the amount of outside air passed thru the evaporative cooling chamber rather than altering the flow of liquid being cooled. Accuracy is improved, with the cooling effects directly proportioned to load changes, giving a modulated, nearly straight-line temperature control. Water savings are increased and, when used to cool oils or compounds, there is no settling of solids, restricted flow or clogging of tubes to interrupt operations. Only the minimum amount of outside air is admitted, keeping spray water temperature above freezing to prevent damage to equipment in cold weather.

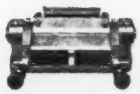
✦ ✦ ✦

WITH this automatic temperature control, the Heat Exchanger may be used for cooling water, oils, solutions, compounds, coolants, chemicals and process materials in such varied fields as heat treat quenching, wire drawing, cutting, grinding and machining coolants; chemical process cooling, plastics, petroleum products; engine jacket water, air and gas compressor jackets, inter and after coolers; transformers and motor generators, electronic apparatus; condensers, bearings, moulds, hydraulic equipment, process and power equipment. More accurate and effective cooling is obtained, water is saved and the use of refrigeration made unnecessary in many applications.

GIRL SAVES MAN HOURS



SHEARS — DI-Acro Shear squares and sizes material, cuts strips, makes slits or notches, trims duplicated stampings. Shearing width — Shear No. 1 — 6". Shear No. 2 — 9". Shear No. 3 — 12".



BRAKES — DI-Acro Brake forms non-stock angles, channels or "Vees". Right or left hand operation. Folding width — Brake No. 1 — 6". Brake No. 2 — 12". Brake No. 3 — 18"

BENDERS — DI-Acro Bender bends angle, channel, rod, tubing, wire, moulding, strip stock, etc. Capacity — Bender No. 1 — 3/8" round cold rolled steel bar. Bender No. 2 — 1/2" cold rolled steel bar.

MAKES PARTS WITHOUT DIES

"Beat The Promise" on delivery this new way: Use The DI-ACRO System of "Meta Duplicating Without Dies" — and finish parts before dies could hardly be started.

DI-ACRO Machines — Shears, Brakes, Benders — are precision-built STANDARDIZED units so designed you can readily convert them into highly SPECIALIZED productive machines suited to your own particular needs. You may adjust, alter or remove any of the original contact surfaces, attach operating clamps, guides and gauges, or quickly set up your own forming surfaces or conversions. Either right or left hand operation and mounting of each unit. The result is a practically unlimited adaptability for a great variety of DIE-LESS DUPLICATING.

Write for catalog — "Metal Duplicating Without Dies".

O'NEIL-IRWIN DI-ACRO PRECISION MACHINES MFG. CO. 303 Eighth Ave. South Minneapolis, Minn.

THE ANNUAL CONVENTION

of the

WIRE ASSOCIATION

will be held this year in Chicago at the LaSalle Hotel

October 18th - 22nd, 1943

in conjunction with the

NATIONAL METAL CONGRESS

Due to the shortage of hotel space because of war conditions, it is advisable to make your room reservations in the LaSalle immediately to be assured of having accommodations in the Wire Association Headquarters hotel.

THE WIRE ASSOCIATION

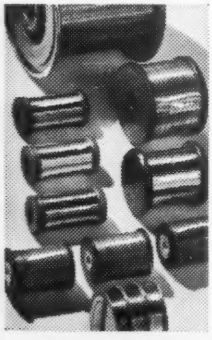
300 MAIN STREET

STAMFORD, CONN

WIRE WON'T WIN the WAR!

No, wire alone won't win the war.

But we do believe that it is contributing its bit. That is why, we here at Callite are doing our very best to make that bit as important a contribution as we know how. Today C-T wire is serving in hundreds of wartime applications. Some we can't talk about, and other uses are commonplace. But the efficient performance of C-T wire in all of these applications, adds up to a wire "know-how" that might very well prove of service to you in solving your wire problems. Our metallurgists will be glad to cooperate with you. Callite Tungsten Corporation, 572 Thirty-ninth St., Union City, New Jersey. Branch offices in Chicago and Cleveland.



Callite fine wires in sizes as small as .002" (smaller if required) for springs, control cables, instruments, wire cloth, brushes, bonding jumpers, etc. are available in:

Aluminum, Beryllium - Copper, Brass (all grades), Commercial Bronze, Everdur, Nickel - Silver, Phosphor-Bronze, Silver, Stainless Steel and Special Alloys.

CALLITE TUNGSTEN CORPORATION CT

REG. U.S. PAT. OFF.

CALLITE WIRES

A FINE WIRE FOR EVERY NEED

Firth - Sterling Steel Company Awarded Army-Navy "E" Award

THE ceremonies in connection with the awarding of the Army-Navy "E" to the **Firth-Sterling Steel Company** of McKeesport, Penna., were held at the plant on Friday, May 7th, 1943 at 4:00 P. M. Music was furnished by the McKeesport High School Band and presentation was made by **Lt. Col. Robert C. Downie,** Deputy District Chief, Pittsburgh Ordnance District. The acceptance of award was made by **L. Gerald Firth,** President of the Company and during the raising of the flag the McKeesport High School Band played "The Caissons Go Rolling Along" and "Anchors Aweigh."

✦ ✦ ✦

FOLLOWING the acceptance of the award the presentation of Token "E" Pins was made by **Commander Carl E. Egeler**, U. S. N. R., in Charge of Naval Inspection, Munhall-Pittsburgh Area. The "E" Pins were presented to **Patrick Donoghue,** Oldest Employee, Steel Department; **Joseph J. Aigner,** Oldest Employee, Globe Wire Department; **William B. West,** Oldest Employee, Carbide Department; **August E. Palmer,** Oldest Employee of the Company, and the acceptance on behalf of the employees was made by **August E. Palmer.**

✦ ✦ ✦

THE ceremony concluded with the playing of the "Star Spangled Banner" by the McKeesport High School Band.

✦ ✦ ✦

IN the program booklet issued by the Firth-Sterling Company, a short history of the Company is given entitled "Behind the Production Record."

✦ ✦ ✦

"THE history of Firth-Sterling Steel Company has been one of service in both war and peace. During the Spanish-American war in 1898, shortly after the Company was organized, the Nation was thrilled by Admiral Dewey's vic-

HELP ON EXPEDITING YOUR WAR WORK!

By providing more thorough and faster degreasing and drawing of wire, Oakite Composition No. 24 and other specialized Oakite materials are not only helping increase output in many mills, but also are enabling them to secure such other outstanding advantages as:

1. **SHORTER BAKING TIME**
2. **BRIGHTER WIRE**
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There is no obligation in finding out how Oakite materials can be adapted to your war work so that you, too, may enjoy the same benefits. Write today!

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Technical Service Representatives Located in All Principal Cities of the United States and Canada

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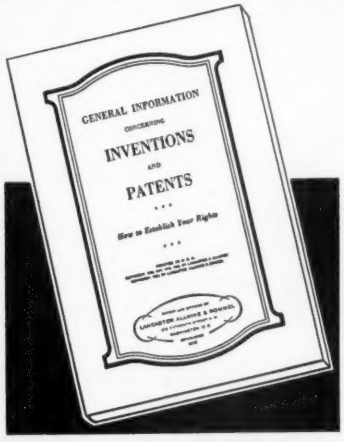

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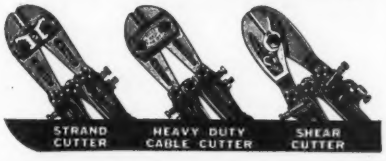

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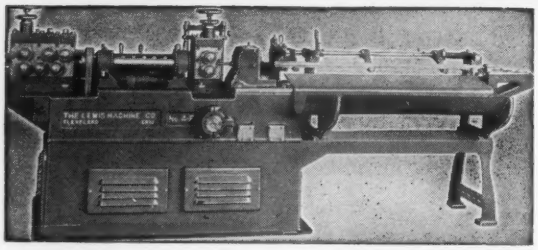

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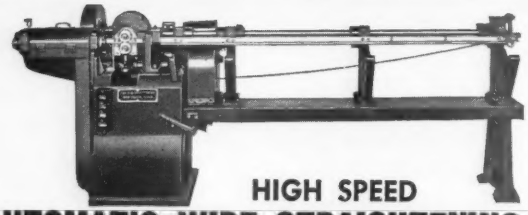

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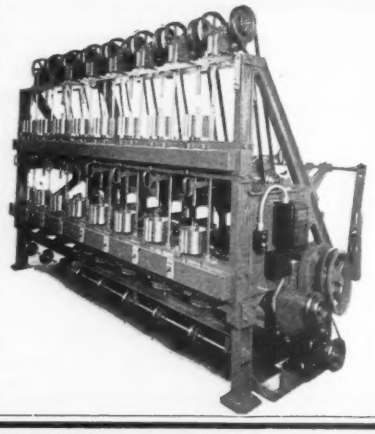

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Miniature Steel Mill Solves Plane Problem

A BABY steel mill that turns out ingots weighing only 13 pounds is playing an important part in America's expanding war-plane program, officials at the Westinghouse Research Laboratories disclosed recently. **Howard Scott** and **William Johnson,** Westinghouse research metallurgists, used the mill to replace a thermometer manufacturer's dwindling supply of Kovar and avert a threatened break in production of temperature gauges for bomber and fighter planes.

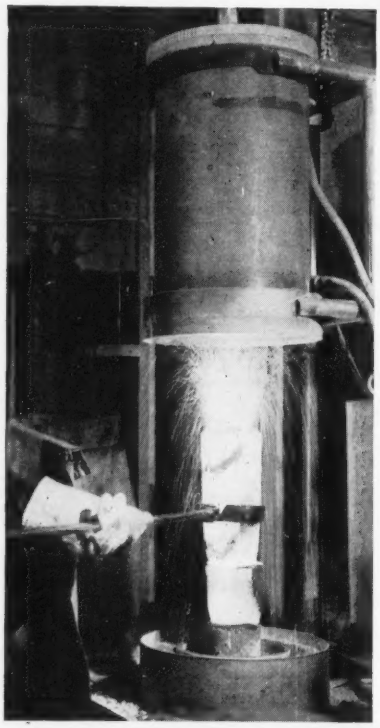

Fig. 1. MINIATURE STEEL MILL AIDS UNCLE SAM—Richard Ballentine, laboratory assistant, is shown above lifting a crucible of white hot metal from an electric furnace at the Westinghouse Research Laboratories. He pours the metal in a small mold to make a 13-pound ingot. With this miniature steel mill Westinghouse research metallurgists succeeded in duplicating a complicated steel alloy, used in thermometers which electrically measure the temperature of engines in Uncle Sam's war planes.

✦ ✦ ✦

KOVAR, a special metal alloy which can be drawn into a delicate wire only two-thirds as thick as a strand of human hair, was developed by Westinghouse as a metal sealer for electronic tubes. Then, according to Mr. Scott, it was unexpectedly adopted by the thermometer manufacturer to make a key part of his device,

which electrically measures the heat in airplane engines and wings. A three-foot length of Kovar wire is tightly coiled inside a metal tube immersed in the engine oil. As the motor warms up the wire becomes hot and offers more resistance to a small electric current passing through it. This is instantly reflected by a pointer on the pilot's instrument board. Made in large batches in regular Westinghouse production furnaces, the resistance properties of the metal are ordinarily not important. But to the thermometer concern the resistance of the alloy particularly the way the resistance increases as the metal gets hotter, were vital.

✦ ✦ ✦

AS war demands depleted the manufacturer's original supply of wire, he sought more that would resist the electric current at precisely the same rate. He tried sample after sample of Kovar without success. Production was threatened because the thermometer design was based on the resistance of the old wire and there was no time to re-design the whole device. His problem was turned over to the Westinghouse laboratories. Within a few weeks, the two metallurgists sent four suitable Kovar ingots to the thermometer plant. Each one was the result of painstaking measurement of the alloy ingredients and careful cooking of the mixture in a tiny electric furnace. After each ingot was cooled and forged into a rod, samples from it were closely checked for resistance values in the laboratory.

✦ ✦ ✦

BY making minute changes in the ingredients and in the melting process, the research men produced an exact duplicate of the original Kovar supply; thus the plane thermometer output can keep pace with the air forces' demands. A half dozen ingots of metal with the proper resistance will keep this plant supplied for years to come, Mr. Scott claims. Each ingot contains enough Kovar to make 56 miles of wire and that's enough wire to make thermometers for 20,000 four-motored bombers.

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✦ ✦ ✦

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THE Magnus Chemical Company, Inc., Garwood, N. J., announces the appointment of **H. L. Trembicki** as Manager of its newly organized Wire Coating Division.

✦ ✦ ✦

MR. Trembicki has had a wide range of experience in the metal working and wire drawing industries. He started his business career as foreign representative for a large steel manufacturer.

✦ ✦ ✦

IN the period following, he devoted his time to metal cleaning problems and to the development of lubricants and coatings on wire to eliminate the adverse effects of lime in drawing operations.

✦ ✦ ✦

DURING this time, Mr. Trembicki was successful in developing a process for drawing wire without the use of lime—a process which has been adopted by several of the leading wire mills in this country.

✦ ✦ ✦

AS Manager of this Division, Mr. Trembicki will specialize in servicing the wire and steel industries with this new process which will also be extended to include deep drawing of steel and other metals.

✦ ✦ ✦

THE services of Mr. Trembicki and the wire Coating Division are available to the wire industry for the solution of difficult wire drawing problems, especially on fine high carbon, stainless and alloy wires.

✦ ✦ ✦

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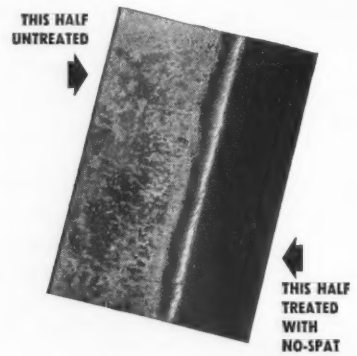

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WHERE TO BUY

For more complete information, consult the annual Wire and Wire Products Directory, Index & Buyers' Guide.

ABRASIVES—
Norton Co., Worcester, Mass.

ACID INHIBITORS—
American Chemical Paint Co., Ambler, Pa.

AIR DRAW FURNACES—
Carl-Mayer Corp., The, Cleveland, Ohio.

ALKALINE CLEANERS—
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.

ANNEALING MACHINES—Open Flame
Syncro Machine Co., Rahway, N. J.

ANNEALING POTS AND BOXES—
National Annealing Box Co., Washington, Penna.
Scudder, E. J., Foundry & Machine Co., Trenton, N. J.

ARMORING EQUIPMENT—
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Watson Machine Co., Paterson, N. J.

BAKERS—Hi-Speed
Carl-Mayer Corp., The, Cleveland, Ohio.

BAKERS—Rod and Wire
Carl-Mayer Corp., The, Cleveland, Ohio.
Morgan Construction Co., Worcester, Mass.
Morrison Engr. Corp., Cleveland, Ohio.
Moslo Machinery Co., Cleveland, Ohio.
Ross, J. O., Engineering Corp., New York, N. Y.

BENDERS—
O'Neil-Irwin Mfg. Co., Minneapolis, Minn.

BERYLLIUM COPPER — Strip and Bars
Callite Tungsten Corp., Union City, N. J.

BOBBINS—Braider and Wire Weaving
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.

BORON CARBIDE—
Norton Co., Worcester, Mass.

BRAKES & SHEARS—
O'Neil-Irwin Mfg. Co., Minneapolis, Minn.

CABLE LACQUERING OVENS
Industrial Oven Engr. Co., Cleveland, Ohio.

CARRIERS—Braider, High Speed
Apco Mossberg Co., Attleboro, Mass.
Carter, B. & F., & Co., Ltd., Bolton, England.
Mossberg Pressed Steel Corp., Attleboro, Mass.

CEMENTS—Refractory
Norton Co., Worcester, Mass.

CHEMICALS—Cleaning
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.
Oakite Products, Inc., New York, N. Y.
Standard Industrial Compounds Co., Chicago, Ill.

CLEANERS—Hand and Metal
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.
Oakite Products, Inc., New York, N. Y.
Standard Industrial Compounds Co., Chicago, Ill.

CLEANING & PICKLING EQUIPMENT—
Broden Construction Co., Cleveland, O.

WHERE TO BUY, Continued

Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, Ohio.
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

CLOTH TESTERS—
Scott, Henry L., Co., Providence, R. I.

CLOTH—Wire, All Metals
Callite Tungsten Corp., Union City, N. J.

COATING COMPOUNDS—
Apex Alkali Products Co., Philadelphia, Pa.
Gilron Products Co., Cleveland, Ohio
Standard Industrial Compounds Co., Chicago, Ill.

COILERS—Sheet, Strip and Wire
Broden Construction Co., Cleveland, O.
Ruesch, H. J., Machine Co., Newark, N. J.
Torrington Mfg. Co., Torrington, Conn.

COLD HEADERS—
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

COMPOUNDS—Coppering
American Chemical Paint Co., Ambler, Pa.

COMPOUNDS—Metal Finishing
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.

COMPOUNDS—Rust Preventing
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.

COMPOUNDS—Rust Removing
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.

COMPOUNDS—Wire Drawing
Apex Alkali Products Co., Philadelphia, Pa.
Gilron Products Co., Inc., Cleveland, Ohio.
Oakite Products, Inc., New York, N. Y.
Standard Industrial Compounds Co., Chicago, Ill.

CONTROLS—Heat Treating
Niagara Blower Co., Buffalo, N. Y.

CONTROLS—Temperature
Niagara Blower Co., Buffalo, N. Y.

COPHOLDERS—Steel
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.

CRANES—Wire Mill
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, Ohio.
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

CUTTING TOOLS—Carbide
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel Co., McKeesport, Pa.
Vascoloy-Ramet Corp., North Chicago, Ill.

CUTTING TOOLS—Wire
Porter, H. K., Inc., Everett, Mass.

DIAMONDS—Industrial
Callite Tungsten Corp., Union City, N. J.

DIAMOND POWDERS—
Rusch Wire Die Corp., New York, N. Y.

DIAMOND TOOLS—
Rusch Wire Die Corp., New York, N. Y.

DIE MAKING MACHINERY — For Forming Special Shapes
O'Neil-Irwin Mfg. Co., Minneapolis, Minn.

DIES—Diamond
Ajax Industrial Supplies, Inc., Fort Wayne, Ind.
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Cochaud Wire Die Corp., New York, N. Y.
Fort Wayne Wire Die, Inc., Fort Wayne, Ind.
Indiana Wire Die Co., Fort Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
Luginbill Wire Die Co., Fort Wayne, Ind.
Rusch Wire Die Corp., New York, N. Y.
Vianney Wire Die Works, New York, N. Y.
Wayne Wire Die Co., Hillside, N. J.

DIES—Lead Extrusion
Robertson, John, Co., Brooklyn, N. Y.

DIES—Repairs & Re-Cutting
Ajax Industrial Supplies Co., Fort Wayne, Ind.
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Carboloy Co., Inc., Detroit, Mich.
Cochaud Wire Die Corp., New York, N. Y.
Firth-Sterling Steel Co., McKeesport, Pa.
Fort Wayne Wire Die, Inc., Fort Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
Luginbill Wire Die Co., Fort Wayne, Ind.
Rusch Wire Die Corp., New York, N. Y.
Vascoloy-Ramet Corp., North Chicago, Ill.
Vianney Wire Die Works, New York, N. Y.
Wayne Wire Die Co., Hillside, N. J.
Willey's Carbide Tool Co., Detroit, Mich.

DIES—Rod and Tube Drawing
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel Co., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., New York, N. Y.
Tungsten Electric Corp., Union City, N. J.
Vascoloy-Ramet Corp., North Chicago, Ill.
Vianney Wire Die Works, New York, N. Y.
Willey's Carbide Tool Co., Detroit, Mich.

DIES—Tantalum Carbide
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel Co., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., New York, N. Y.
Vascoloy-Ramet Corp., North Chicago, Ill.
Vianney Wire Die Works, New York, N. Y.
Willey's Carbide Tool Co., Detroit, Mich.

DIES—Tungsten Carbide
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel Co., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., New York, N. Y.
Tungsten Electric Corp., Union City, N. J.
Vascoloy-Ramet Corp., North Chicago, Ill.
Vianney Wire Die Works, New York, N. Y.
Willey's Carbide Tool Co., Detroit, Mich.

DRAW BENCHES—
Ruesch, H. J., Machine Co., Newark, N. J.
Scudder, E. J., Foundry & Machine Co., Trenton, N. J.
Standard Machinery Co., Providence, R. I.
Vaughn Machinery Co., Cuyahoga Falls, O.

DRUMS—Flange Steel
Stevens Metal Products Co., Niles, O.

DRUMS—Vulcanizing
Mossberg Pressed Steel Corp., Attleboro, Mass.

DRYING EQUIPMENT—
Niagara Blower Co., Buffalo, N. Y.

ENGINEERS—Consulting Wire Mill
Hartley, George D., Worcester, Mass.
Lewis, Kenneth B., Worcester, Mass.

EQUIPMENT—Humidifying
Niagara Blower Co., Buffalo, N. Y.

EQUIPMENT—Industrial Cooling
Niagara Blower Co., Buffalo, N. Y.

EQUIPMENT—Insulation Testing
Davis, R. L., Electric Co., Wallingford, Conn.

EYELETS—Brass or Zinc
Platt Bros. & Co., The, Waterbury, Conn.

FLUX—Galvanizing
Dewey & Almy Chemical Co., Cambridge, Mass.

FLUXES—Soldering
American Chemical Paint Co., Ambler, Pa.

FOAM PRODUCING COMPOUNDS—
American Chemical Paint Co., Ambler, Pa.

FURNACES—Annealing
Carl-Mayer Corp., The, Cleveland, Ohio.
Electric Furnace Co., Salem, O.
Rockwell, W. S., Co., New York, N. Y.
Surface Combustion, Div. of General Properties Co., Inc., Toledo, Ohio.

FURNACES—Automatic
Carl-Mayer Corp., The, Cleveland, Ohio.
Electric Furnace Co., Salem, O.
Rockwell, W. S., Co., New York, N. Y.
Surface Combustion, Div. of General Properties Co., Inc., Toledo, Ohio.

FURNACES—Brazing
Electric Furnace Co., Salem, O.
Firth-Sterling Steel Co., McKeesport, Pa.

FURNACES—Bright Annealing
Electric Furnace Co., Salem, O.
Rockwell, W. S., Co., New York, N. Y.
Surface Combustion, Div. of General Properties Co., Inc., Toledo, Ohio.

FURNACES—Electric
Electric Furnace Co., Salem, Ohio
Rockwell, W. S., Co., New York, N. Y.
Surface Combustion, Div. of General Properties Co., Inc., Toledo, Ohio

FURNACES—Hardening & Tempering
Carl-Mayer Corp., The, Cleveland, Ohio
Electric Furnace Co., Salem, Ohio
Rockwell, W. S., Co., New York, N. Y.
Surface Combustion, Div. of General Properties Co., Inc., Toledo, Ohio

FURNACES—Lead Melting
Electric Furnace Co., Salem, Ohio
Robertson, John, Co., Brooklyn, N. Y.

FURNACES—Non-Oxidizing
Carl-Mayer Corp., The, Cleveland, Ohio
Electric Furnace Co., Salem, Ohio
Rockwell, W. S., Co., New York, N. Y.
Surface Combustion, Div. of General Properties Co., Inc., Toledo, Ohio

FURNACES—Normalizing
Carl-Mayer Corp., The, Cleveland, Ohio
Electric Furnace Co., Salem, Ohio
Rockwell, W. S., Co., New York, N. Y.

FURNACES—Salt Bath
Electric Furnace Co., Salem, Ohio
Surface Combustion, Div. of General Properties Co., Inc., Toledo, Ohio.

FURNACES—Wire, Strip & Sheet
Carl-Mayer Corp., The, Cleveland, Ohio
Electric Furnace Co., Salem, Ohio
Rockwell, W. S., Co., New York, N. Y.
Surface Combustion, Div. of General Properties Co., Inc., Toledo, Ohio.

GALVANIZING FLUX—
Dewey & Almy Chemical Co., Cambridge, Mass.

GALVANIZING KETTLES—
National Annealing Box Co., Washington, Penna.

GRINDERS—Roll
Norton Co., Worcester, Mass.

HI-SPEED BAKERS—
Carl-Mayer Corp., The, Cleveland, Ohio

HOISTS—Electric Travelling
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, O.

INHIBITORS—
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.

KETTLES—Galvanizing, Annealing, Tinning, etc.
National Annealing Box Co., Washington, Penna.

LATHES—Die Reaming
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

LIQUID FOAM BLANKET—
Dewey & Almy Chemical Co., Cambridge, Mass.

LUBRICANTS—For Metal Cutting, Stamping and Drawing
Apex Alkali Products Co., Philadelphia, Pa.
Standard Industrial Compounds Co., Chicago, Ill.

LUBRICANTS—Wire Drawing
Apex Alkali Products Co., Philadelphia, Pa.
Bick, Hans C., Inc., Reading, Pa.
Oakite Products, Inc., New York, N. Y.
Standard Industrial Compounds Co., Chicago, Ill.

MACHINERY—Armoring (Cable, Wire Hose)
American Insulating Mach'y. Co., Phila., Pa.
National Wire Machinery Co., Lynn, Mass.
New England Butt Co., Providence, R. I.
Robertson, John, Co., Brooklyn, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Braiding
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Robinson Mfg. Co., Muncy, Pa.
Watson Machine Co., Paterson, N. J.

MACHINERY—Brazing
National Wire Machinery Co., Lynn, Mass.

MACHINERY—Bunching
American Insulating Mach'y. Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Bundling, Scrap
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Watson Machine Co., Paterson, N. J.

MACHINERY—Cable, Electric
American Insulating Mach'y. Co., Phila., Pa.
Fidelity Machine Co., Philadelphia, Pa.
National Wire Machinery Co., Lynn, Mass.
New England Butt Co., Providence, R. I.
Syncro Machine Co., Rahway, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Chain Making
Nilson, A. H., Machine Co., The, Bridgeport, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Closing
New England Butt Co., Providence, R. I.
Robinson Mfg. Co., Muncy, Pa.
Watson Machine Co., Paterson, N. J.

WHERE TO BUY, Continued

MACHINERY—Coil Winding
Robinson Mfg. Co., Muncy, Pa.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.

MACHINERY—Coilers
Broden Construction Co., Cleveland, Ohio
Morgan Construction Co., Worcester, Mass.
New England Butt Co., Providence, R. I.
Ruesch, H. J., Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., Torrington, Conn.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Copper Wire Drawing and Rolling
Ruesch, H. J., Machine Co., Newark, N. J.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

MACHINERY—Covering Wire
Fidelity Machine Co., Philadelphia, Pa.
Syncro Machine Co., Rahway, N. J.

MACHINERY—Cutting
Broden Construction Co., Cleveland, Ohio
Lewis Machine Co., The, Cleveland, Ohio
Moslo Machinery, Inc., Cleveland, Ohio
National Machinery Exchange (Used), New York, N. Y.
Nilson, A. H., Machine Co., The, Bridgeport, Conn.
Shuster, F. B., Co., New Haven, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Die Making
Firth-Sterling Steel Co., McKeesport, Pa.

MACHINERY — Die Making for Forming Special Shapes
O'Neil-Irwin Mfg. Co., Minneapolis, Minn.

MACHINERY—Draw Benches
Standard Machinery Co., Providence, R. I.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Edging
Standard Machinery Co., Providence, R. I.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Enameling
American Insulating Mach'y. Co., Phila., Pa.
Syncro Machine Co., Rahway, N. J.

MACHINERY—Extruding
Robertson, John, Co., Brooklyn, N. Y.
Royle, John, & Sons, Paterson, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Flat Wire
Broden Construction Co., Cleveland, Ohio
Ruesch, H. J., Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Forming
National Machinery Exchange (Used), New York, N. Y.
Nilson, A. H., Machine Co., The, Bridgeport, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Machinery Co., Providence, R. I.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Galvanizing Wire
Broden Construction Co., Cleveland, O.
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Gang Winders
Fidelity Machine Co., Philadelphia, Pa.
Robinson Mfg. Co., Muncy, Pa.
Ruesch, H. J., Machine Co., Newark, N. J.
Syncro Machine Co., Rahway, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Grinding
Norton Co., Worcester, Mass.

MACHINERY—Insulating
American Insulating Mach'y Co., Phila., Pa.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Royle, John, & Sons, Paterson, N. J.
Syncro Machine Co., Rahway, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Knitting
Fidelity Machine Co., Philadelphia, Pa.

MACHINERY—Lead Encasing Presses, etc.
Robertson, John, Co., Brooklyn, N. Y.

MACHINERY—Lead Stripping
Robertson, John, Co., Brooklyn, N. Y.
Watson Machine Co., Paterson, N. J.

MACHINERY—Lock Washer
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Magnet Wire
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Material Handling
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, Ohio.

MACHINERY — Measuring Wire & Cable
Davis, R. L., Electric Co., Wallingford, Conn.
Durant Mfg. Co., Milwaukee, Wis.
Lyon-Vail Machine Co., Brockton, Mass.
New England Butt Co., Providence, R. I.
Robinson Mfg. Co., Muncy, Pa.
Watson Machine Co., Paterson, N. J.

MACHINERY—Nail and Tack
Glader, Wm., Machine Works, Chicago, Ill.
National Machinery Exchange (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Panning
American Insulating Mach'y Co., Phila., Pa.
Syncro Machine Co., Rahway, N. J.

MACHINERY—Pointing
Broden Construction Co., Cleveland, Ohio
Ruesch, H. J., Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Machinery Co., Providence, R. I.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

MACHINERY—Quill Winding
Fidelity Machine Co., Philadelphia, Pa.

MACHINERY—Rod Mill
Broden Construction Co., Cleveland, Ohio
Morgan Construction Co., Worcester, Mass.
Ruesch, H. J., Machine Co., Newark, N. J.

MACHINERY—Rolling Mill
Broden Construction Co., Cleveland, Ohio
Morgan Construction Co., Worcester, Mass.
National Machinery Exchange (Used), New York, N. Y.
Ruesch, H. J., Machine Co., Newark, N. J.
Standard Machinery Co., Providence, R. I.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., Torrington, Conn.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

MACHINERY—Rubber for Insulating Wire
Royle, John, & Sons, Paterson, N. J.

MACHINERY—Rubber Strip Covering
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Rubber Tubing and Straining
New England Butt Co., Providence, R. I.
Royle, John, & Sons, Paterson, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Screw Wire
National Machinery Exchange (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Special
American Insulating Mach'y Co., Phila., Pa.
Broden Construction Co., Cleveland, Ohio
Emory, Robert J., Co., Newark, N. J.
New England Butt Co., Providence, R. I.
Robinson Mfg. Co., Muncy, Pa.
Ruesch, H. J., Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Machinery Co., Providence, R. I. (Special Designs)
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Spooling
American Insulating Mach'y Co., Phila., Pa.
Emory, Robert J., Co., Newark, N. J.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Robinson Mfg. Co., Muncy, Pa.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Spring Making
National Machinery Exchange (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Staple
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Straightening
Broden Construction Co., Cleveland, Ohio
Lewis Machine Co., The, Cleveland, Ohio
Moslo Machinery Co., Cleveland, Ohio
National Machinery Exchange (Used), New York, N. Y.
Nilson, A. H., Machine Co., The, Bridgeport, Conn.
Ruesch, H. J., Machine Co., Newark, N. J.
Shuster, F. B., Co., New Haven, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Stranding
National Wire Machinery Co., Lynn, Mass.
New England Butt Co., Providence, R. I.
Robinson Mfg. Co., Muncy, Pa.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Strip Steel
Broden Construction Co., Cleveland, Ohio
Ruesch, H. J., Machine Co., Newark, N. J.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Swaging
National Machinery Exchange (Used), New York, N. Y.
Ruesch, H. J., Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Machinery Co., Providence, R. I.
Syncro Machine Co., Rahway, N. J.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

MACHINERY—Taping
American Insulating Mach'y Co., Phila., Pa.
Fidelity Machine Co., Philadelphia, Pa.
National Wire Machinery Co., Lynn, Mass.
New England Butt Co., Providence, R. I.
Syncro Machine Co., Rahway, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Testing
Robinson Mfg. Co., Muncy, Pa.
Scott, Henry L., Co., Providence, R. I.

MACHINERY—Testing Size of Wire
Davis, R. L., Electric Co., Wallingford, Conn.

MACHINERY—Testing Spring
Standard Machinery Co., Providence, R. I.

MACHINERY—Tinsel Rolling Mills
American Insulating Mach'y Co., Phila., Pa.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Trolley Wire
Vaughn Machinery Co., Cuyahoga Falls, O.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Tube Mill
Ruesch, H. J., Machine Co., Newark, N. J.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Welding Wire
Micro Products Co., Chicago, Ill.
National Wire Machinery Co., Lynn, Mass.
Shuster, F. B., Co., New Haven, Conn.

MACHINERY—Winding
American Insulating Mach'y Co., Phila., Pa.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Bending
O'Neil-Irwin Mfg. Co., Minneapolis, Minn.

MACHINERY—Wire Drawing
American Insulating Mach'y Co., Phila., Pa.
Broden Construction Co., Cleveland, Ohio
Morgan Construction Co., Worcester, Mass.
National Machinery Exchange (Used), New York, N. Y.
National Wire Machinery Co., Lynn, Mass.
Robinson Mfg. Co., Muncy, Pa.
Ruesch, H. J., Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Machinery Co., Providence, R. I.
Syncro Machine Co., Rahway, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

MACHINERY—Wire Measuring
Durant Mfg. Co., Milwaukee, Wis.
Lyon-Vail Machine Co., Inc., Brockton, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Rope
National Wire Machinery Co., Lynn, Mass.
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

WHERE TO BUY, Continued

MACHINERY—Wire Tinning
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Syncro Machine Co., Rahway, N. J.

MACHINERY—Wood Screw
National Machinery Exchange (Used), New York, N. Y.

MATERIAL HANDLING EQUIPMENT
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, O.

MILLS—Tandem Rolling and Edging
Standard Machinery Co., Providence, R. I.
Torrington Mfg. Co., Torrington, Conn.

NICKEL SILVER AND PHOSPHOR BRONZE—Rod, Wire and Strip
Hudson Wire Co., Ossining, N. Y.

OILS—Wire Drawing
Apex Alkali Products Co., Philadelphia, Pa.
Standard Industrial Compounds Co., Chicago, Ill.

OVENS—Cable Lacquering
Industrial Oven Engr. Co., Cleveland, Ohio

OVENS—Industrial
Carl-Mayer Corp., The, Cleveland, Ohio
Industrial Oven Engr. Co., Cleveland, Ohio
Ross, J. O., Engineering Corp., New York, N. Y.

PAINTS—Heat Resisting
American Chemical Paint Co., Ambler, Pa.

PAINTS—Marine
American Chemical Paint Co., Ambler, Pa.

PAINTS—Structural Steel
American Chemical Paint Co., Ambler, Pa.

PANS—Lead and Spelter
National Annealing Box Co., Washington, Penna.

PANS—Vulcanizing
Mossberg Pressed Steel Corp., Attleboro, Mass.

PAPER—Creped Wrapping
Crepe-Kraft Co., Newark, N. J.

PAPER TESTERS—
Scott, Henry L., Co., Providence, R. I.

PATENT ATTORNEYS—
Lancaster, Allwine and Rommel, Washington, D. C.

PICKLING COMPOUNDS—
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.

PLASTIC TESTERS—
Scott, Henry L., Co., Providence, R. I.

POTS—Lead Melting
Robertson, John, Co., Brooklyn, N. Y.

POWDER—Wire Drawing
Apex Alkali Products Co., Philadelphia, Pa.

PRESSES—Hydraulic and Mechanical
Robertson, John, Co., Brooklyn, N. Y.
Standard Machinery Co., Providence, R. I. (Mechanical Only)

PRESSES—Lead
Robertson, John, Co., Brooklyn, N. Y.

PRESSURE VESSELS—
National Annealing Box Co., Washington, Penna.

PULLERS—Wire
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.

PUMPS—Hydraulic
Robertson, John, Co., Brooklyn, N. Y.

QUENCHING BATH CONTROLS—
Niagara Blower Co., Buffalo, N. Y.

REEL AND TENSION STAND—
Fidelity Machine Co., Philadelphia, Pa.
Moslo Machinery Co., Cleveland, Ohio
Robinson Mfg. Co., Muncy, Pa.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.

REEL CRUTCHES—
Watson Machine Co., Paterson, N. J.

REELS—Annealing and Stranding
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Moslo Machinery Co., Cleveland, Ohio
Mossberg Pressed Steel Corp., Attleboro, Mass.
Shuster, F. B., Co., New Haven, Conn.
Stevens Metal Products Co., Niles, O.

REELS—Steel
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

REELS AND SPOOLS—Shipping and Shop
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

REELS—Takeoff
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Moslo Machinery Co., Cleveland, Ohio
Mossberg Pressed Steel Corp., Attleboro, Mass.
Shuster, F. B., Co., New Haven, Conn.
Stevens Metal Products Co., Niles, O.

REELS—Vulcanizing and Impregnating
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Shuster, F. B., Co., New Haven, Conn.
Stevens Metal Products Co., Niles, O.

REELS—Wire Drawing
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Moslo Machinery Co., Cleveland, Ohio
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

REFRACTORIES—High Temperature
Norton Co., Worcester, Mass.

ROD BAKERS—
Carl-Mayer Corp., The, Cleveland, Ohio
Moslo Machinery Co., Cleveland, Ohio
Ross, J. O., Engineering Corp., New York, N. Y.

RODS—Wire—Non-Ferrous
Hudson Wire Co., Ossining, N. Y.
Platt Bros. & Co., The, Waterbury, Conn.

RODS—Wire—Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Indiana.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.

ROLL STRAIGHTENERS—
Moslo Machinery Co., Cleveland, Ohio

RUBBER AND RUBBER COMPRESSION TESTERS—
Scott, Henry L., Co., Providence, R. I.

RUST PROOF COMPOUNDS—
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.

RUST REMOVING COMPOUNDS—
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.

SHEARS—
O'Neil-Irwin Mfg. Co., Minneapolis, Minn.

SHEET—Steel
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.

SOAPS—Industrial and Wire Drawing
Apex Alkali Products Co., Philadelphia, Pa.
Standard Industrial Compounds Co., Chicago, Ill.

SPOOLS—Annealing and Wire Drawing
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

SPOOLS—Shipping and Shop
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

SPOOLS—Steel
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

STAMPINGS—Steel
Hubbard Spool Co., Chicago, Ill
Mossberg Pressed Steel Corp., Attleboro, Mass.

STRIP—Brass and Non-Ferrous
Hudson Wire Co., Ossining, N. Y.

STRIP—Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Firth-Sterling Steel Co., McKeesport, Pa.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.

STRIP METAL TESTERS—
Scott, Henry L., Co., Providence, R. I.

SWIFTS—Take-off
Apco Mossberg Co., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.

TANKS—Compound
Watson Machine Co., Paterson, N. J.

TANKS—Steel
Mossberg Pressed Steel Corp., Attleboro, Mass.

TEMPERATURE CONTROLS—
Niagara Blower Co., Buffalo, N. Y.

TENSILE TESTERS—
Scott, Henry L., Co., Providence, R. I.

TESTING INSTRUMENTS—
Scott, Henry L., Co., Providence, R. I.

TOOLS—Wire Cutting
Porter, H. K., Inc., Everett, Mass.

TRAMRAIL SYSTEMS—
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, O.

TREADS—Safety
Norton Co., Worcester, Mass.

TRUCKS—
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

TUBE BENDERS AND FORMERS—
Ruesch, H. J., Machine Co., Newark, N. J.

TURKS HEADS—Friction and Power Driven
Standard Machinery Co., Providence, R. I.

VULCANIZERS—
Watson Machine Co., Paterson, N. J.

VULCANIZING PANS—
American Insulating Mach'y Co., Phila., Pa.
Mossberg Pressed Steel Corp., Attleboro, Mass.

WELDERS—Spot and Butt
Micro Products Co., Chicago, Ill.
Moslo Machinery Co., Cleveland, Ohio

WIRE—Cold Heading
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Indiana.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.

WIRE—Electric
Hudson Wire Co., Ossining, N. Y.

WIRE—Enameled for Coils
Winsted Div. of Hudson Wire Co., Winsted, Conn.

WIRE—Manufacturers
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Firth-Sterling Steel Co., McKeesport, Pa.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Wickwire Bros., Inc., Cortland, N. Y.

WIRE—Music
Jersey Steel & Wire Corp., Irvington, N. J.

WIRE—Nickel Silver and Phosphor Bronze
Callite Tungsten Corp., Union City, N. J.
Hudson Wire Co., Ossining, N. Y.

WIRE—Non-Ferrous to Specification for Special Purposes
Callite Tungsten Corp., Union City, N. J.
Hudson Wire Co., Ossining, N. Y.
Winsted Div. of Hudson Wire Co., Winsted, Conn.

WIRE—Spring
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Firth-Sterling Steel Co., McKeesport, Pa.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.

WIRE—Stainless Steel
Callite Tungsten Corp., Union City, N. J.
Firth-Sterling Steel Co., McKeesport, Pa.

WIRE—Steel—Also Coppered Steel—Also Galvanized Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Wickwire Bros., Inc., Cortland, N. Y.

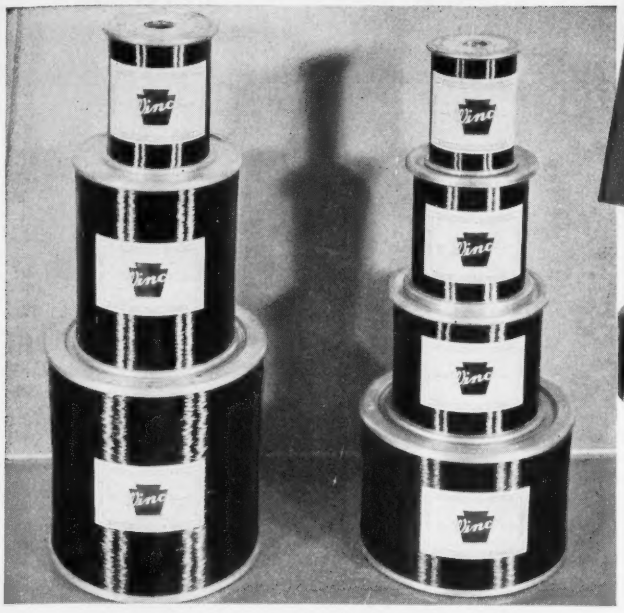
WIRE AND STRIP—Zinc
Platt Bros. & Co., The, Waterbury, Conn.

WIRE TESTERS—
Scott, Henry L., Co., Providence, R. I.

WIRE, WEAVING—Non-Ferrous
Hudson Wire Co., Ossining, N. Y.

WRAPPING PAPER—Creped
Crepe-Kraft Co., Newark, N. J.

YARN TESTERS—
Scott, Henry L., Co., Providence, R. I.



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Checking raw materials

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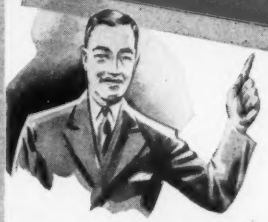

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UNIFORMITY — By mercury process tests, our engineers can guarantee perfect uniformity in wire; from the smallest to the largest order. No more variations in consistency, structure or electrical properties . . . every inch of wire exactly as specified, more than meeting your requirements.

SERVICE—If you have a wire problem, our complete design and engineering facilities are at your disposal without obligation. Send your specifications and blueprints for our recommendations; or if you are not quite ready, write for samples of these quality products.

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For Every Industrial Heat Treating Process

E F Gas Fired Continuous Chain Belt Conveyor Type Furnaces

For Scale-Free Hardening Bolts, Springs

and Miscellaneous Other Parts and Products

- - - 300 to 1700 lbs. per Hour

The above E F gas fired furnace installation is one of several similar installations we have made for scale-free hardening bolts. E F Continuous Chain Belt Conveyor Type Furnaces are handling all kinds of products ranging in sizes from small springs and machine gun cartridge clips up to large crawler links for tanks and tractors. Hundreds of these furnaces are in operation.

The material is loaded directly onto rugged heat resisting cast link belt conveyors. Without further attention, it is carried through the furnace, uniformly heated to the proper temperature and automatically discharged through a sealed chute to the quenching medium or directly from the furnace as desired. The chain belt conveyor returns within the furnace without cooling—no pans or trays are used in the furnace—100% net material.

These furnaces are built for oil, gas or electric heat in five standard sizes with capacities ranging from 300 to 1700 lbs. per hour. Larger or smaller sizes can also be furnished. They are also designed for using special protective atmosphere for scale-free heat treating and hardening without decarburization.

The hundreds of installations in operation, handling all kinds of material, have proven the conveyor type furnaces the most satisfactory and dependable general purpose heat treating machines built for the continuous, uniform, economical, production heat treatment of miscellaneous small and medium size parts and products.

The Chain Belt Conveyor Furnace is only one of the numerous types we build for various heat treating purposes.

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